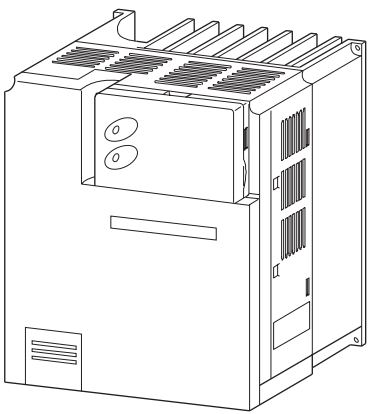
MGI Technologies

INVERTER
M4000E
INSTRUCTION MANUAL

M4500E-001 to 010



OUTLINE Chapter 1

INSTALLATION AND WIRING Chapter 2

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Thank you for choosing the MGI inverter.

This instruction manual gives handling information and precautions for use of this equipment.

Incorrect handling might cause an unexpected fault. Before using the inverter, please read this manual carefully to use the equipment to its optimum.

Please forward this manual to the end user.

This instruction manual uses the International System of Units (SI). The measuring units in the yard and pound system are indicated in parentheses as reference values.

This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect the inverter until you have read through this instruction manual and appended documents carefully and can use the equipment correctly.

Do not use the inverter until you have a full knowledge of the equipment, safety information and instructions.

In this manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠ WARNING Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.

⚠ CAUTION Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that even the **⚠CAUTION** level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

SAFETY INSTRUCTIONS

1. Electric Shock Prevention

⚠ WARNING

- While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover or wiring cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry and get an electric shock.
- If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, check to make sure that the inverter power indicator lamp is off, wait for at least 10 minutes after the power supply has been switched off, and check that there are no residual voltage using a tester or the like. The capacitor is charged with high voltage for some time after power off and it is dangerous.
- This inverter must be grounded. Grounding must conform to the requirements of national and local safety regulations and electrical codes. (JIS, NEC section 250, IEC 536 class 1 and other applicable standards)
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Operate the switches and potentiometers with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.
- Do not change the cooling fan while power is on.
  It is dangerous to change the cooling fan while power is on.

2. Fire Prevention

⚠ CAUTION

- Mount the inverter and brake resistor on an incombustible surface. Installing the inverter directly on or near a combustible surface could lead to a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
- When a brake resistor is used, use an alarm signal to switch power off.
  Otherwise, the brake resistor may excessively overheat due to damage of the brake transistor and such, causing a fire.
- Do not connect a resistor directly to the DC terminals P(+), N(-). This could cause a fire.

3. Injury Prevention

⚠ CAUTION

- Apply only the voltage specified in the instruction manual to each terminal to prevent damage etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, damage etc. may occur.
- Always make sure that polarity is correct to prevent damage etc.
- While power is on and for some time after power-off, do not touch the inverter or brake resistor as they are hot and you may get burnt.

4. Additional Instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.

(1) Transportation and installation

⚠ CAUTION

- When carrying products, use correct lifting gear to prevent injury.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the Instruction Manual.
- Do not operate if the inverter is damaged or has parts missing.
- Do not hold the inverter by the front cover or operation panel; it may fall off.
- Do not stand or rest heavy objects on the inverter.
- Check the inverter mounting orientation is correct.
- Prevent screws, wire fragments or other conductive bodies or oil or other flammable substance from entering the inverter.
- Do not drop the inverter, or subject it to impact.
- Use the inverter under the following environmental conditions:

Environment	Ambient temperature	-10°C to +40°C (14°F to 104°F) (non-freezing)
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature	-20°C to +65°C * (-4°F to 149°F)
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude, vibration	Maximum 1000m (3280.80 feet) above sea level for standard operation. After that derate by 3% for every extra 500m (1640.40 feet) up to 2500m (8202.00 feet) (91%). 5.9m/s^2 or less (conforming to JIS C 60068-2-6)

*Temperatures applicable for a short time, e.g. in transit.

(2) Wiring

⚠ CAUTION

- Do not fit capacitive equipment such as power factor correction capacitor, capacitor type filter or surge suppressor to the output of the inverter.
- The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.

(3) Trial run

⚠ CAUTION

- Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.

(4) Operation

⚠ WARNING

- When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
- The [STOP] key is valid only when the appropriate function setting has been made. Prepare an emergency stop switch separately.
- Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
- The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the equipment.
- Do not modify the equipment.
- Do not perform parts removal which is not instructed in this manual. Doing so may lead to fault or damage of the inverter.

⚠ CAUTION

- The electronic thermal reray function does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/ stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power supply harmonics from the inverter may heat/damage the power capacitor and generator.
- When a 400V class motor is inverter-driven, it should be insulation-enhanced or surge voltages suppressed. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- In addition to the inverter's holding function, install a holding device to ensure safety.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.

(5) Emergency stop

⚠ CAUTION

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.
- When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.
- When any protective function is activated, take the corrective appropriate action, then reset the inverter, and resume operation.

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

- Do not carry out a megger (insulation resistance) test on the control circuit of the inverter.

(7) Disposing of the inverter

⚠ CAUTION

- Treat as industrial waste.

(8) General instructions

Many of the diagrams and drawings in this instruction manual show the inverter without a cover, or partially open. Never operate the inverter in this manner. Always replace the cover and follow this instruction manual when operating the inverter.

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MEMO

CHAPTER 1 OUTLINE

This chapter gives information on the basic "outline" of this product.
Always read the instructions before using the equipment.

1.1 Pre-Operation Information 2
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<Abbreviations>
- PU
  Operation panel (FR-PA02-02) and parameter unit (FR-PU04-MGI)
- Inverter
  MGI inverter M4500E series
- Pr.
  Parameter number

1.1 Pre-Operation Information

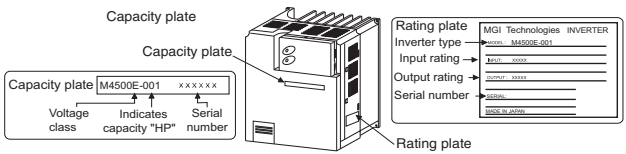
1.1.1 Precautions for operation

This manual is written for the M4500E series transistorized inverters.
Incorrect handling may cause the inverter to operate incorrectly, causing its life to be reduced considerably, or at the worst, the inverter to be damaged. Handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual to use it correctly.
For handling information on the parameter unit (FR-PU04-MGI), stand-alone options, etc., refer to the corresponding manuals.

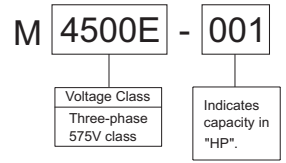
(1) Unpacking and product check

Unpack the inverter and check the capacity plate on the front cover and the rating plate on the inverter side face to ensure that the product agrees with your order and the inverter is intact.

1) Inverter type



- **Inverter type**



2) Accessory
Instruction manual

If you have found any discrepancy, damage, etc., please contact your sales representative.

(2) Preparation of instruments and parts required for operation

Instruments and parts to be prepared depend on how the inverter is operated. Prepare equipment and parts as necessary. (Refer to page 46.)

(3) Installation

To operate the inverter with high performance for a long time, install the inverter in a proper place, in the correct direction, with proper clearances. (Refer to page 14.)

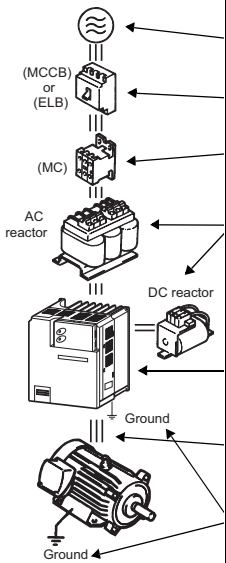
(4) Wiring

Connect the power supply, motor and operation signals (control signals) to the terminal block. Note that incorrect connection may damage the inverter and peripheral devices. (Refer to page 16.)

1.2 Basic Configuration

1.2.1 Basic configuration

The following devices are required to operate the inverter. Proper peripheral devices must be selected and correct connections made to ensure proper operation. Incorrect system configuration and connections can cause the inverter to operate improperly, its life to be reduced considerably, and in the worst case, the inverter to be damaged. Please handle the inverter properly in accordance with the information in each section as well as the precautions and instructions of this manual. (For connections of the peripheral devices, refer to the corresponding manuals.)

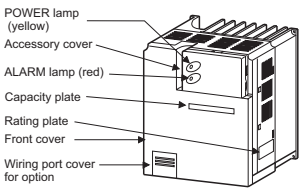


Name	Description
Power supply	Use the power supply within the permissible power supply specifications of the inverter. (Refer to page 190.)
Ground leakage circuit breaker or moulded case circuit breaker	The breaker should be selected with care since a large inrush current flows in the inverter at power on. (Refer to page 41.)
Magnetic contactor	Install for your safety. (Refer to page 42.) Do not use this magnetic contactor to start or stop the inverter. It might reduce the inverter life. (Refer to page 41.)
Reactors	The reactors must be used when the power factor is to be improved or the inverter is installed near a large power supply system (500KVA or more and wiring distance within 10m (32.81 feet)). Make selection carefully.
Inverter	• The life of the inverter is influenced by ambient temperature. The ambient temperature should be as low as possible within the permissible range. This must be noted especially when the inverter is installed in an enclosure. (Refer to page 14.) • Wrong wiring might lead to damage of the inverter. The control signal lines should be kept away from the main circuit to protect them from noise. (Refer to page 16.)
Devices connected to the output	Do not connect a power capacitor, surge suppressor or capacitor type filter on the output side. When installing a moulded case circuit breaker on the output side of the inverter, contact each manufacturer for selection of the moulded case circuit breaker.
Ground	To prevent an electric shock, always ground the motor and inverter. For reduction of induction noise from the power line of the inverter, it is recommended to wire the ground cable by returning it to the ground terminal of the inverter. (Refer to page 39.)

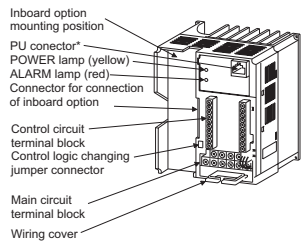
1.3 Structure

1.3.1 Appearance and structure

(1) Front view



(2) Without front cover and accessory cover



Lamp indication

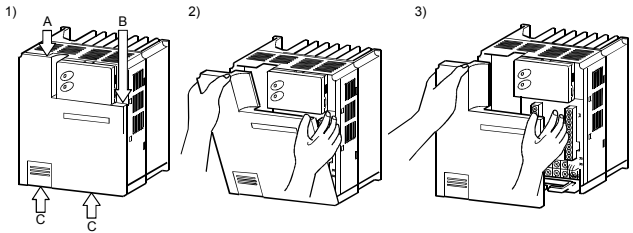
Power lamp.....Lit when power is spplied to the main circuit (R (L1),S (L2),T (L3)).
Alarm lamp.....Lit when the inverter is in the alarm status (major faults).

*Use the PU connector for the FR-PA02-02 or FR-PU04-MGI option and RS-485 communication.

1.3.2 Removal and reinstallation of the front cover

●Removal

The front cover is fixed with hooks in positions A, B and C.
Push A and B in the directions of arrows at the same time and remove the cover using C as supporting points.



●Reinstallation

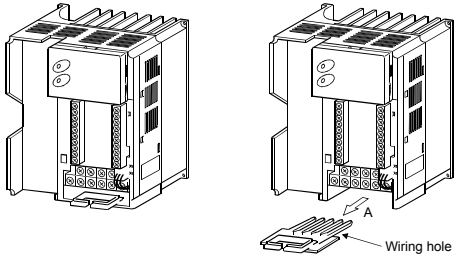
When reinstalling the front cover after wiring, fix the hooks securely.
With the front cover removed, do not switch power on.

Note: 1. Make sure that the front cover has been reinstalled securely.
2. The same serial number is printed on the capacity plate of the front cover and the rating plate of the inverter. Before reinstalling the front cover, check the serial numbers to ensure that the cover removed is reinstalled to the inverter from where it was removed.

1.3.3 Removal and reinstallation of the wiring cover

●Removal

Remove the wiring cover by pulling it in the direction of arrow A.



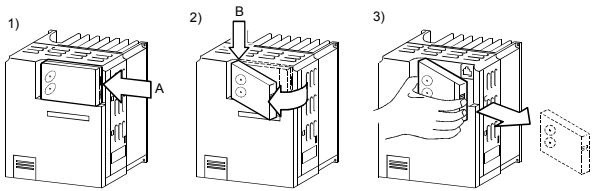
●Reinstallation

Pass the cables through the wiring hole and reinstall the cover in the original position.

1.3.4 Removal and reinstallation of the accessory cover

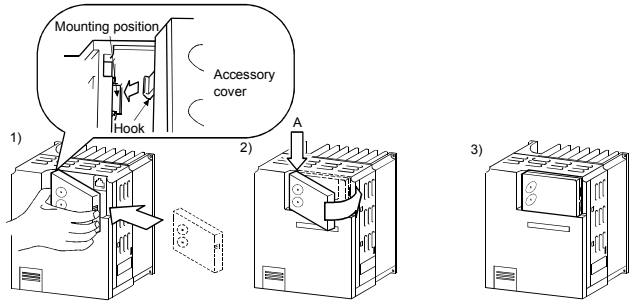
●Removal

Hold down the portion A indicated by the arrow and lift the right hand side using the portion B indicated by the arrow as a support, and pull out the accessory cover to the right.



● Reinstallation

Insert the mounting hook (left hand side) of the accessory cover into the mounting position of the inverter and push in the right hand side mounting hook to install the accessory cover.



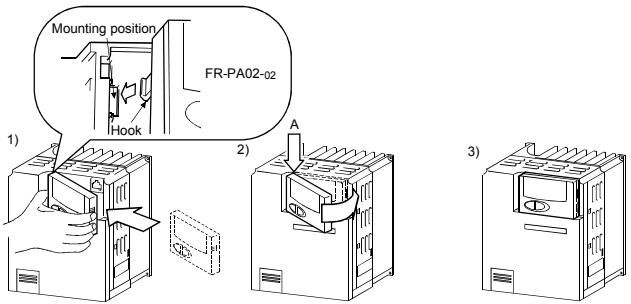
1.3.5 Reinstallation and removal of the operation panel

To ensure safety, reinstall and remove the option operation panel (FR-PA02-02) after switching power off.

The charging area and control printed board are exposed on the rear surface of the operation panel. When removing the operation panel, always fit the rear cover option FR-E5P. Never touch the control printed board because touching it can cause the inverter to fail.

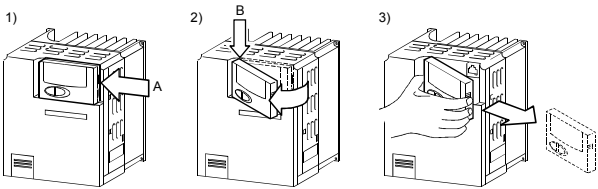
●**Reinstallation**

Insert the mounting hook (left hand side) of the operation panel into the mounting position of the inverter and push in the right hand side mounting catch to install the operation panel.



● **Removal of the operation panel**

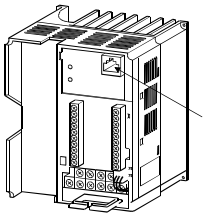
Hold down the portion A indicated by the arrow and lift the right hand side using the portion B indicated by the arrow as a support, and pull out the operation panel to the right.



(If the above procedure is not used for removal, the internal connector may be damaged by the force applied.)

●Using the connection cable for operation

1) Fit the rear cover option FR-E5P to the back surface of the operation panel.
2) Securely plug one end of the connection cable into the PU connector of the inverter and the other end into the adaptor of the FR-E5P option to connect it to the operation panel. (For the connection cable of the FR-E5P, refer to page 28.)

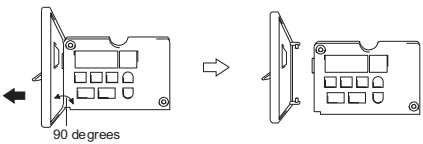


●Mounting the operation panel on an enclosure

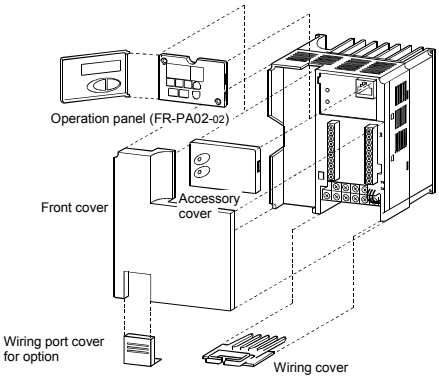
When you open the operation panel front cover, the screw mounting guides for fixing the operation panel to an enclosure appear on the top left and bottom right. Fit the rear cover of the FR-E5P option, drill holes in the operation panel mounting guides, and securely mount the operation panel on the enclosure with screws.

1.3.6 Removal of the operation panel (FR-PA02-02) front cover

1)Open the operation panel front cover to 90 degrees.
2)Pull out the operation panel front cover to the left to remove it.



1.3.7 Exploded view



CAUTION

Do not remove any parts other than the operation panel, front cover, and wiring cover from the inverter. Doing so will damage the inverter.

MEMO

CHAPTER 2
INSTALLATION AND WIRING

This chapter gives information on the basic "installation and wiring" for use of this product.
Always read the instructions in this chapter before using the equipment.

2.1 Installation..... 14
2.2 Wiring..... 16
2.3 Other Wiring..... 34

2.1 Installation

2.1.1 Instructions for installation

1) Handle the unit carefully.
   The inverter uses plastic parts. Handle it gently to protect it from damage.
   Also, hold the unit with even strength and do not apply too much strength to the front cover alone.

2) Install the inverter in a place where it is not affected by vibration easily (5.9m/s^2 maximum).
   Note the vibration of a cart, press, etc.

3) Note on the ambient temperature.
   The inverter life is under great influence of the ambient temperature. In the place of installation, the ambient temperature must be within the permissible range -10°C to +40°C (14°F to 104°F). Check that the ambient temperature is within that range in the positions shown in figure 3).

4) Install the inverter on a non-combustible surface.
   The inverter will be very hot (maximum about 150°C (302°F)). Install it on a non-combustible surface (e.g. metal). Also leave sufficient clearances around the inverter.

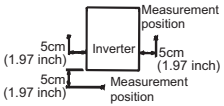
5) Avoid high temperature and high humidity.
   Avoid direct sunlight and places of high temperature and high humidity.

6) Avoid places where the inverter is exposed to oil mist, flammable gases, fluff, dust, dirt etc.
   Install the inverter in a clean place or inside a "totally enclosed" panel which does not accept any suspended matter.

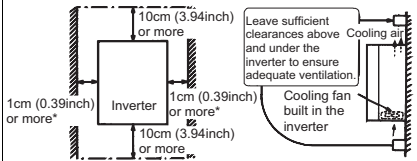
7) Note the cooling method when the inverter is installed in an enclosure.
   When two or more inverters are installed or a ventilation fan is mounted in an enclosure, the inverters and ventilation fan must be installed in proper positions with extreme care taken to keep the ambient temperatures of the inverters with the permissible values. If they are installed in improper positions, the ambient temperatures of the inverters will rise and ventilation effect will be reduced.

8) Install the inverter securely in the vertical direction with screws or bolts.

3) Note on ambient temperatures

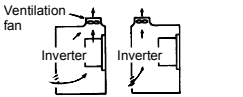


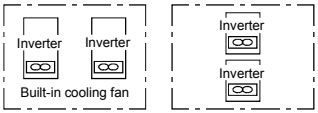
4) Clearances around the inverter


10cm (3.94inch) or more
1cm (0.39inch) or more*
Inverter
1cm (0.39inch) or more*
10cm (3.94inch) or more
Leave sufficient clearances above and under the inverter to ensure adequate ventilation.
Cooling air
Cooling fan built in the inverter

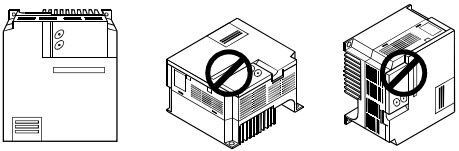
*5cm (1.97inch) or more for 007.5 and 010
These clearances are also necessary for changing the cooling fan.
(The 002 or more is provided with a cooling fan)

7) For installation in an enclosure





8) Vertical mounting

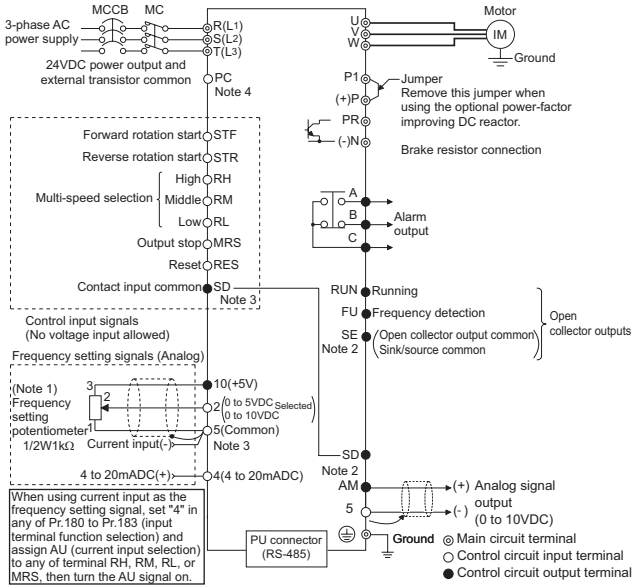


2

2.2 Wiring

2.2.1 Terminal connection diagram

● **3-phase 575V power input**



Note: 1. If the potentiometer is to be operated often, use a 2W1kΩ potentiometer.
2. Terminals SD and SE are isolated.
3. Terminals SD and 5 are common terminals. Do not ground them to the ground.
4. When terminals PC-SD are used as a 24VDC power supply, be careful not to short these terminals. If they are shorted, the inverter will be damaged.

(1) Description of the main circuit terminals

Symbol	Terminal Name	Description
R, S, T (L_1, L_2, L_3)	AC power input	Connect to the commercial power supply.
U, V, W	Inverter output	Connect a three-phase squirrel-cage motor.
P (+), PR	Brake resistor connection	Connect the optional brake resistor across terminals P-PR (+ - PR).
P (+), N (-)	Brake unit connection	Connect the optional brake unit.
P (+), P1	Power factor improving DC reactor connection	Disconnect the jumper from terminals P-P1 (+ - P1) and connect the optional power factor improving DC reactor.
⏚	Ground	For grounding the inverter chassis. Must be grounded.

(2) Description of the control circuit terminals

Type		Symbol	Terminal Name	Description	
Input signals	Contact input	STF	Forward rotation start	Turn on the STF signal to start forward rotation and turn it off to stop.	When the STF and STR signals are turned on simultaneously, the stop command is given.
		STR	Reverse rotation start	Turn on the STR signal to start reverse rotation and turn it off to stop.	
		RH, RM, RL	Multi-speed selection	Combine the RH, RM and RL signals as appropriate to select multiple speeds.	Input terminal function selection (Pr. 180 to Pr. 183) changes terminal functions.
		MRS	Output stop	Turn on the MRS signal (20ms or longer) to stop the inverter output. Used to shut off the inverter output to bring the motor to a stop by the electromagnetic brake.	
		RES	Reset	Used to reset the protective circuit activated. Turn on the RES signal for more than 0.1s then turn it off. Factory setting is for reset always. By setting Pr.75, reset can be set to enabled only at an inverter alarm occurrence. (Refer to page 108.) Recover about 1s after reset is cancelled.	
	SD		Contact input common (sink*)	Common to the contact input terminals. Common output terminal for 24VDC 0.1A power output (PC terminal).	
	PC		Power output and external transistor common Contact input common (source*)	When transistor output (open collector output), such as a programmable controller (PLC), is connected, connect the external power supply common for transistor output to this terminal to prevent a fault caused by undesirable current. This terminal can be used as a 24VDC, 0.1A power output.	
Analog	Frequency setting	10	Frequency setting power supply	5VDC, permissible load current 10mA	
		2	Frequency setting (voltage)	By entering 0 to 5VDC (0 to 10VDC), the maximum output frequency is reached at 5V (or 10V) and I/O are proportional. Use Pr. 73 to switch between input 0 to 5VDC (factory setting) and 0 to 10VDC. Input resistance 10kΩ. Maximum permissible voltage 20V.	
		4	Frequency setting (current)	By entering 4 to 20mADC, the maximum output frequency is reached at 20mA and I/O are proportional. This input signal is valid only when the AU signal (Note) is on (voltage input is invalid). Input resistance approximately 250Ω. Maximum permissible current 30mA.	
	5		Frequency setting common	Common to the frequency setting signals (terminal 2, 1 or 4). Do not connect to the ground.	

Note: Assign the AU signal to any of the terminals using the input terminal function selection (Pr. 180 to Pr. 183).

* Used as a contact input signal common terminal by switching between sink logic and source logic. (Refer to page 25.)

Type		Symbol	Terminal Name	Description	
Output signals	Contact	A, B, C	Alarm output	Change-over contact output indicating that the output has been stopped by the inverter protective function activated. 230VAC 0.3A, 30VDC 0.3A. Alarm: discontinuity across B-C (continuity across A-C), normal: continuity across B-C (discontinuity across A-C).	Output terminal function selection (Pr. 190 to Pr. 192) changes terminal functions.
	Open collector	RUN	Inverter running	Switched low when the inverter output frequency is equal to or higher than the starting frequency (factory set to 0.5Hz, variable). Switched high during stop or DC injection brake operation (*1). Permissible load 24VDC 0.1A. (a voltage drop is 3.4V maximum when the signal is on)	
		FU	Frequency detection	Switched low when the output frequency has reached or exceeded the detection frequency set as appropriate. Switched high when the output frequency is below the detection frequency (*1). Permissible load 24VDC 0.1A	
		SE	Open collector output common	Common to the RUN and FU terminals	
	Analog	AM	Analog signal output	One selected from output frequency, motor current and output voltage is output (*2). The output signal is proportional to the magnitude of each monitoring item.	Factory setting of output item: Frequency output signal 0 to 10 VDC Permissible load current 1mA
Communication	RS-485	——	PU connector	With the operation panel connector, communication can be made using the RS-485 protocol. • Conforming Standard : EIA Standard RS-485 • Transmission format : Multi-drop link system • Communication speed : Maximum 19200bps • Overall length : 500m (1640.40 feet)	

*1: Low indicates that the open collector output transistor is on (conducts). High indicates that the transistor is off (does not conduct).

*2: Not output during inverter resetting.

2.2.2 Wiring of the Main Circuit

(1) Wiring instructions

1) It is recommended to use insulation-sleeved crimping terminals for power supply and motor cables.
2) Application of power to the output terminals (U, V, W) of the inverter will damage the inverter. Never perform such wiring.
3) After wiring, wire off-cuts must not be left in the inverter.
   Wire off-cuts can cause an alarm, failure or malfunction. Always keep the inverter clean. When drilling mounting holes in a control box etc., be careful so that chips and others do not enter the inverter.
4) Use thick cables to make the voltage drop 2% or less.
   If the wiring distance is long between the inverter and motor, a main circuit cable voltage drop will cause the motor torque to decrease, especially at the output of a low frequency. (A selection example for the wiring length of 20m (65.62 feet) is shown on page 22.)
5) The overall wiring length should be 500m (1640.40feet) maximum.
   Especially for long distance wiring, the fast-response current limit may be misactivated under the influence of a charging current due to the stray capacitance of the wiring. The fast-response current limit must be turn off by Pr.156 when the total wiring length is more than the indicated value in the following table for M4500E-001 to 010.

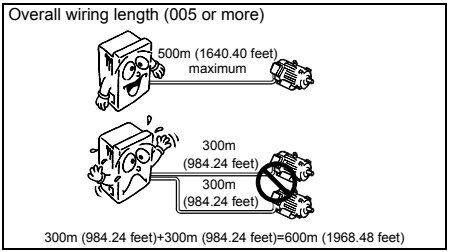
Inverter Capacity	001	002	003	005	007.5	010
Non-low acoustic noise mode	100 (328.08)	100 (328.08)	100 (328.08)	200 (656.16)	400 (1312.34)	500 (1640.40)
Low acoustic noise mode	100 (328.08)	100 (328.08)	100 (328.08)	200 (656.16)	300 (984.24)	400 (1312.34)

(Unit: m (feet))

Even though the fast-response current limit is turned off , in more long distance wiring situations the over current protection may be misactivated or the devices connected to the output side may misoperate or become faulty under the influence of a charging current due to the stray capacitance of the wiring.
Therefore, the maximum overall wiring length should be as indicated in the following table. (When two or more motors are connected to the inverter, the total wiring length should be within the indicated value.)

Inverter Capacity	001	002	003	005 or more
Total wiring length	100 (328.08)	200 (656.16)	300 (984.24)	500 (1640.40)

(Unit: m (feet))


Overall wiring length (005 or more)
500m (1640.40 feet) maximum
300m (984.24 feet)
300m (984.24 feet)
300m (984.24 feet)+300m (984.24 feet)=600m (1968.48 feet)

6) Connect only the recommended optional brake resistor between the terminals P-PR (+ - PR).
   These terminals must not be shorted.
   Also, never short these terminals.
7) Electromagnetic wave interference
   The input/output (main circuit) of the inverter includes harmonic components, which may interfere with the communication devices (such as AM radios) used near the inverter. In this case, install the FR-BSF01 or FR-BLF line noise filter to minimize interference.
8) Do not install a power capacitor, surge suppressor or capacitor type filter on the output side of the inverter.
   This will cause the inverter to trip or the capacitor and surge suppressor to be damaged. If any of the above devices are installed, immediately remove them.
9) When rewiring after operation, make sure that the POWER lamp has gone off, and when more than 10 minutes has elapsed after power-off, check with a meter etc. that the voltage is zero. After that, start rewiring work. For some time after power-off, there is a dangerous voltage in the capacitor.

Notes on Grounding

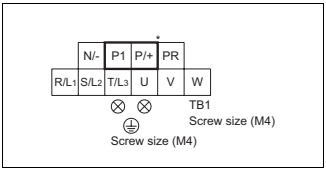
- Leakage currents flow in the inverter. To prevent an electric shock, the inverter and motor must be grounded. Grounding must conform to the requirements of national and local safety regulations and electrical codes.
  (JIS, NEC section 250, IEC 536 class 1 and other applicable standards)
- Use the dedicated ground terminal to ground the inverter. (Do not use the screw in the case, chassis, etc.) For the ground connection, avoid direct contact between aluminium and copper. Tin-plated cable lugs can be used if the plating does not contain zinc. When tightening the screws, take care not to damage the thread in the aluminium frame.
- Use the thickest possible ground cable. Use the cable whose size is equal to or greater than that indicated below, and minimize the cable length. The grounding point should be as near as possible to the inverter.

(Unit: mm^2)

Motor Capacity	Ground Cable Gauge
3.7kW (5HP) or less	3.5
5.5kW (7.5HP), 7.5kW (10HP)	5.5

- Ground the motor on the inverter side using one wire of the 4-core cable.

(2) Terminal block layout of the power circuit



* A jumper is connected across P1-P/+.

(3) Cables, crimping terminals, etc.

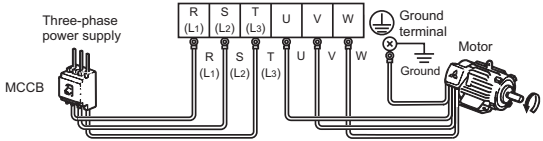
The following table lists the cables and crimping terminals used with the inputs (R (L_1), S (L_2), T (L_3)) and outputs (U, V, W) of the inverter and the torques for tightening the screws:

Applicable Inverter Type	Terminal Screw Size	Tightening Torque N·m	Crimping Terminals		HIV Cables			
					mm^2		AWG	
			R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W	R, S, T (L_1, L_2, L_3)	U, V, W
M4500E-001	M4	1	2-4	2-4	2	2	14	14
M4500E-002	M4	1	2-4	2-4	2	2	14	14
M4500E-003	M4	1	2-4	2-4	2	2	14	14
M4500E-005	M4	1	2-4	2-4	2	2	14	14
M4500E-007.5	M4	1	2-4	2-4	2	2	14	14
M4500E-010	M4	1	5.5-4	2-4	3.5	2	12	14

Note: 1. The cables used should be 75°C (167°F) copper cables.
2. Tighten the terminal screws to the specified torques.
Undertightening can cause a short or misoperation.
Overtightening can cause the screws and unit to be damaged, resulting in a short or misoperation.

(4) Connection of the power supply and motor

● **Three-phase power input**



The power supply cables must be connected to R, S, T (L1, L2 ,L3). If they are connected to U, V, W, the inverter will be damaged.
(Phase sequence need not be matched.)

Connect the motor to U, V, W. In the above connection, turning on the forward rotation switch (signal) rotates the motor in the counterclockwise (arrow) direction when viewed from the load shaft.

Note: To ensure safety, connect the power input to the inverter via a magnetic contactor and ground leakage circuit breaker or moulded case circuit breaker, and use the magnetic contactor to switch power on-off.

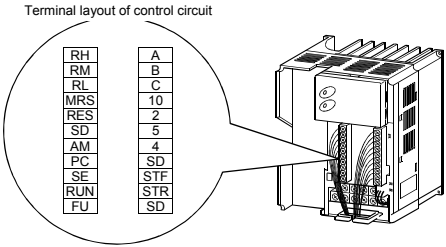
2.2.3 Wiring of the control circuit

(1) Wiring instructions

1) Terminals SD, SE and 5 are common to the I/O signals. These common terminals must not be grounded to the ground.
   Terminals SD and 5 are isolated. Avoid connecting the terminal SD and 5 and the terminal SE and 5.
2) Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits.
3) The frequency input signals to the control circuit are micro currents. When contacts are required, use two or more parallel micro signal contacts or a twin contact to prevent a contact fault.
4) It is recommended to use the cables of 0.3mm^2 to 0.75mm^2 gauge for connection to the control circuit terminals.

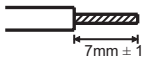
(2) Terminal block layout

In the control circuit of the inverter, the terminals are arranged as shown below:
Terminal screw size: M2.5



(3) Wiring method

1) For wiring the control circuit, use cables after stripping their sheaths.
   Refer to the gauge printed on the inverter and strip the sheaths to the following dimensions. If the sheath is stripped too much, its cable may be shorted with the adjoining cable. If the sheath is stripped too little, the cable may come off.



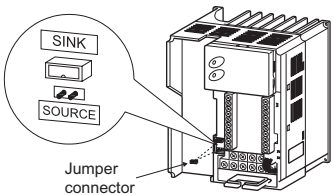
2) When using bar terminals and solid wires for wiring, their diameters should be 0.9mm maximum. If they are larger, the threads may be damaged during tightening.
3) Loosen the terminal screw and insert the cable into the terminal.
4) Tighten the screw to the specified torque.
   Undertightening can cause cable disconnection or misoperation. Overtightening can cause damage to the screw or unit, leading to short circuit or misoperation.
   Tightening torque: 0.25N·m to 0.49N·m
   *Use a size 0 screwdriver to tighten.

Note: When routing the stripped cables, twist them so that they do not become loose. In addition, do not solder it.

(4) Control logic changing

The input signal logic is factory-set to the sink logic.
To change the control logic, the position of the jumper connector must be changed.

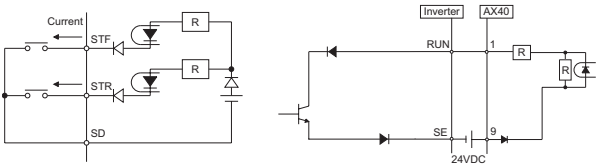
1) Use tweezers etc. to remove the jumper connector in the sink logic position and fit it in the source logic position.
   Do this position changing before switching power on.



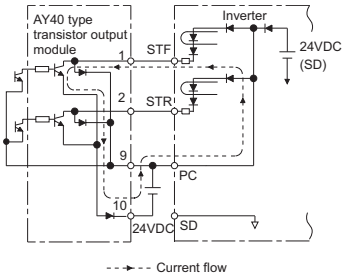
Note: 1. Make sure that the front cover has been installed securely.
2. The front cover has a capacity plate and the inverter a rating plate on it. Since these plates have the same serial numbers, always reinstall the removed cover to the inverter from where it was removed.
3. Always install the sink-source logic changing jumper connector in either of the positions. If two connectors are installed in these positions at the same time, the inverter may be damaged.

2) Sink logic type

- In this logic, a signal switches on when a current flows out of the corresponding signal input terminal.
  Terminal SD is common to the contact input signals. Terminal SE is common to the open collector output signals.

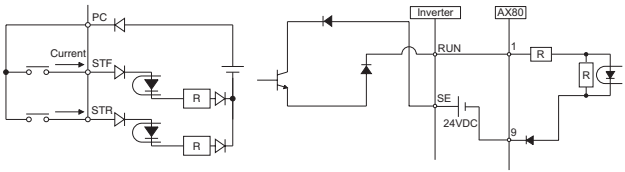


- Use terminal PC as a common terminal to prevent a malfunction caused by undesirable current.
  (Do not connect terminal SD of the inverter with terminal 0V of the external power supply. When using terminals PC-SD as a 24VDC power supply, do not install the power supply in parallel outside the inverter. Doing so may cause misoperation due to undesirable current.)

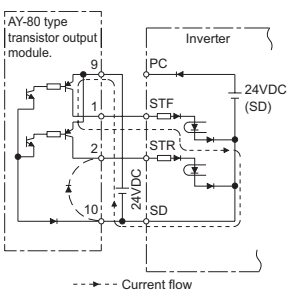


3) Source logic type

- In this logic, a signal switches on when a current flows into the corresponding signal input terminal.
  Terminal PC is common to the contact input signals. Terminal SE is common to the open collector output signals.

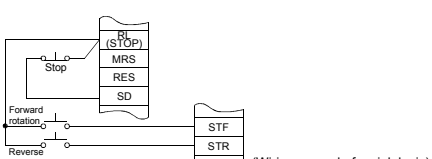


- When using an external power supply for transistor output, use terminal SD as a common to prevent misoperation caused by undesirable current.



(5) How to use the STOP signal

The following connection example shows how to self-hold the start signals (forward rotation, reverse rotation).
Use Pr. 180 to Pr. 183 (input terminal function selection) to assign the STOP signal.



(Wiring example for sink logic)

2.2.4 Connection to the PU connector

(1) When connecting the operation panel or parameter unit using a cable

Use the option FR-CB2□□ or the following connector and commercially available cable:

<Connection cable>

- Connector: RJ45 connector
  Example: 5-554720-3, Tyco Electronics Corporation
- Cable: :Cable conforming to EIA568 (e.g. 10BASE-T cable)

<When using the operation panel>

Note: The rear cover and junction adaptor are required since the circuit board is exposed in the back of the operation panel. Use the FR-E5P option (cover and adaptor available as a set).

<Maximum wiring length>

- Operation panel (FR-PA02-02): 20m (65.62 feet)
- Parameter unit (FR-PU04-MGI): 20m (65.62 feet)

(2) For RS-485 communication

The PU connector can be used for communication operation from a personal computer etc.
When the PU connector is connected with a personal, FA or other computer by a communication cable, a user program can run and monitor the inverter or read and write to the parameters.

<PU connector pin-outs>

Viewed from the inverter (receptacle side) front

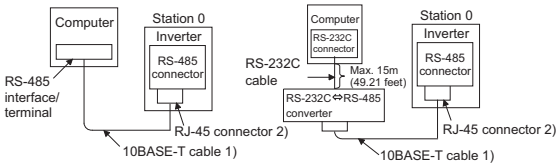
8) to 1)

1) SG 5) SDA
2) P5S 6) RDB
3) RDA 7) SG
4) SDB 8) P5S

Note: 1. Do not connect the PU connector to a computer's LAN board, FAX modem socket or telephone modular connector. Otherwise, the product may be damaged due to electrical specification differences.
2. Pins 2) and 8) (P5S) provide power to the operation panel or parameter unit.
Do not use these pins for RS-485 communication.
3. Refer to page 122 for the communication parameters.

<System configuration example>

(1) Connection of a computer to the inverter (1:1 connection)



- Computer-inverter connection cable

  For a connection cable between the computer having RS-232C and the inverter (RS-232C⇔RS-485 converter), refer to the table below.

  Example of product available on the market (as of April, 2004)

Model	Maker
FA-T-RS40□*	Mitsubishi Electric Engineering Co., Ltd.

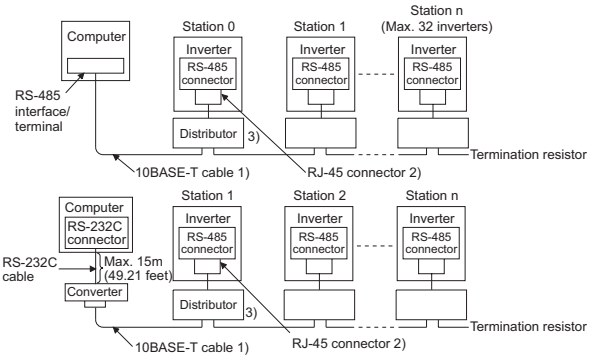
* The converter cable cannot connect two or more inverters (the computer and inverter are connected on a 1:1 basis). Since the product is packed with the RS-232C cable and RS-485 cable (10BASE-T + RJ-45 connector), the cable and connector need not be prepared separately. Contact a maker for details of the product.

REMARKS

Refer to the following when fabricating the cable on the user side.
Example of product available on the market (as of April, 2004)

	Product	Model	Maker
1)	10BASE-T cable	SGLPEV-T 0.5mm × 4P * Do not use No. 2 and No. 8 pin (P5S).	Mitsubishi Cable Industries, Ltd.
2)	RJ-45 connector	5-554720-3	Tyco Electronics Corporation

(2) Connection of a computer to multiple inverters (1:n connection)



REMARKS

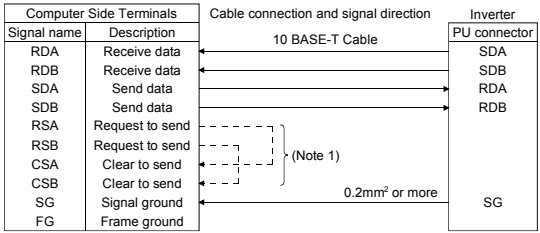
Refer to the following when fabricating the cable on the user side.
Example of product available on the market (as of April, 2004)

	Product	Model	Maker
1)	10BASE-T cable	SGLPEV-T 0.5mm × 4P*	Mitsubishi Cable Industries, Ltd.
2)	RJ-45 connector	5-554720-3	Tyco Electronics Corporation

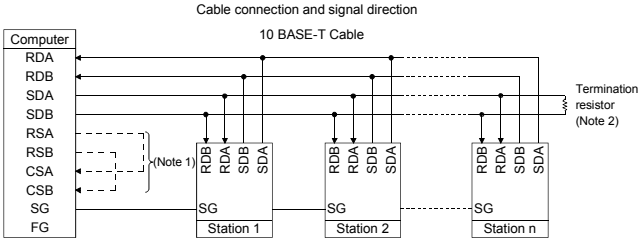
* Do not use No. 2 and No. 8 pin (P5S) of the 10 BASE-T cable.

<Wiring methods>

1) Wiring of one RS-485 computer and one inverter



2) Wiring of one RS-485 computer and "n" inverters (several inverters)



Note: 1. Make connections in accordance with the instruction manual of the computer used.
Fully check the terminal numbers of the computer as they differ between models.

2. There may be the influence of reflection depending on the transmission speed and/or transmission distance. If this reflection hinders communication, provide a termination resistor. If the PU connector is used to make a connection, use the distributor as a termination resistor cannot be fitted.
Connect the termination resistor to only the inverter remotest from the computer. (Termination resistor: 100Ω)

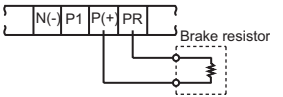
2.2.5 Connection of stand-alone option units

The inverter accepts a variety of stand-alone option units as required.
Incorrect connection will cause inverter damage or an accident. Connect and operate the option unit carefully in accordance with the corresponding option unit manual.

(1) Connection of the dedicated external brake resistor (option)

Connect a brake resistor across terminals P (+) and PR. Connect a dedicated brake resistor only.
(For the locations of terminals P (+) and PR, refer to the terminal block layout (page 22).)
The external brake resistor should be as listed in the following table. Selected the rated power of the brake resistor according to the brake duty.(The rated power indicated below assumes that the brake resistor duty is 10%)

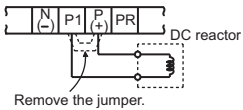
Inverter size	Brake resistance	Reference rated power at brake duty of 10%
001	1000 ohm minimum	180W minimum
002	500 ohm minimum	360W minimum
003	350 ohm minimum	500W minimum
005	200 ohm minimum	800W minimum
007.5	150 ohm minimum	1200W minimum
010	110 ohm minimum	1600W minimum



(2) Connection of the power factor improving DC reactor

Connect the power factor improving DC reactor between terminals P1-P (+). In this case, the jumper connected across terminals P1-P (+) must be removed. Otherwise, the reactor will not function.

<Connection method>



Note: 1. The wiring distance should be within 5m (16.40 feet).
2. The size of the cables used should be equal to or larger than that of the power supply cables (R (L_1), S (L_2), T (L_3)).

2.2.6 Design information

1) When performing commercial power supply-inverter switch-over operation, securely provide electrical and mechanical interlocks for the MC1 and MC2 used for commercial power supply-inverter switch-over.
   When there is a commercial power supply-inverter switch-over circuit as shown below, the inverter will be damaged by leakage current from the power supply due to arcs generated at the time of switch-over or chattering caused by a sequence error.

2) If the machine must not be restarted when power is restored after a power failure, provide a magnetic contactor in the inverter's primary circuit and also make up a sequence which will not switch on the start signal.
   If the start signal (start switch) remains on after a power failure, the inverter will automatically restart as soon as the power is restored.

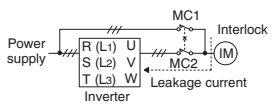
3) Since the input signals to the control circuit are on a low level, use two or more parallel micro signal contacts or a twin contact for contact inputs to prevent a contact fault.

4) Do not apply a large voltage to the contact input terminals (e.g. STF) of the control circuit.

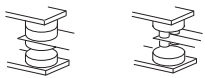
5) Always apply a voltage to the alarm output terminals (A, B, C) via a relay coil, lamp etc.

6) Make sure that the specifications and rating match the system requirements.

1) Commercial power supply-inverter switch-over



3) Low-level signal contacts



2.3 Other Wiring

2.3.1 Power supply harmonics

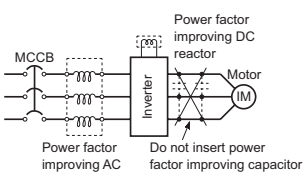
Power supply harmonics may be generated from the converter section of the inverter, affecting the power supply equipment, power capacitor, etc. Power supply harmonics are different in generation source, frequency band and transmission path from radio frequency (RF) noise and leakage currents. Take the following counter measures.

● **The differences between harmonics and RF noises are indicated below:**

Item	Harmonics	RF Noise
Frequency	Normally 40th to 50th degrees or less (up to 3kHz or less)	High frequency (several 10kHz to 1GHz order)
Environment	To wire paths, power impedance	Across spaces, distance, laying paths
Quantitative understanding	Logical computation is possible	Occurs randomly, quantitative understanding is difficult.
Generated amount	Approximately proportional to load capacity	According to current fluctuation rate (larger with faster switching)
Immunity of affected device	Specified in standards for each device.	Differs according to maker's device specifications.
Examples of safeguard	Install a reactor.	Increase the distance.

● **Countermeasures**

The harmonic current generated from the inverter to the power supply differs according to various conditions such as the wiring impedance, whether a power factor improving reactor is used or not, and output frequency and output current on load side.
For the output frequency and output current, the adequate method is to obtain them under rated load at the maximum operating frequency.



Note: A power factor improving capacitor and surge suppressor on the inverter's output side may overheat or be damaged due to the harmonics of the inverter output. Also, when an overcurrent flows in the inverter, the overcurrent protection is activated. Hence, when the motor is driven by the inverter, do not install a capacitor or surge suppressor on the inverter's output side. To improve the power factor, insert a power factor improving reactor in the inverter's input or DC circuit.

2.3.2 Inverter-generated noise and reduction techniques

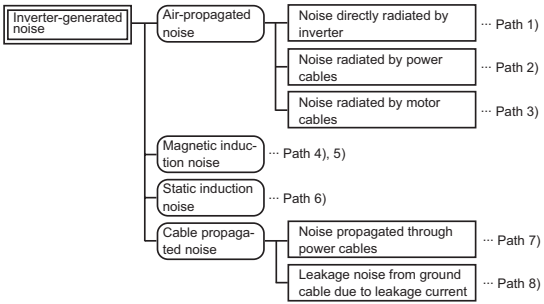
Some noises enter the inverter causing it to incorrectly operate, and others are radiated by the inverter causing misoperation of peripheral devices. Though the inverter is designed to be insusceptible to noise, it handles low-level signals, so it requires the following basic measures to be taken. Also, since the inverter chops the output at high carrier frequencies, it could generate noise. If these noises cause peripheral devices to misoperate, measures should be taken to suppress noise. The measures differ slightly depending on noise propagation paths.

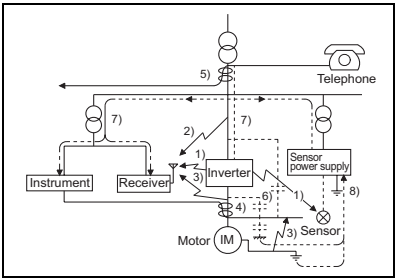
1) Basic measures
   - Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
   - Use twisted shield cables for the detector connecting and control signal cables and connect the sheathes of the shield cables to terminal SD.
   - Ground the inverter, motor, etc. at one point.

2) Measures against noise which enters and causes misoperation of the inverter
   When devices which generate noise (devices which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter, the inverter may misoperate due to noise. The following measures must be taken:
   - Provide surge suppressors for devices that generate noise to suppress noise.
   - Fit data line filters (refer to page 38) to signal cables.
   - Ground the shields of the detector connection and control signal cables with cable clamp metal.

3) Measures against noises which are radiated by the inverter causing misoperation of peripheral devices.

Inverter-generated noises are largely classified into those radiated by the cables connected to the inverter and inverter main circuit (I/O), those electromagnetically and electrostatically inducted to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.



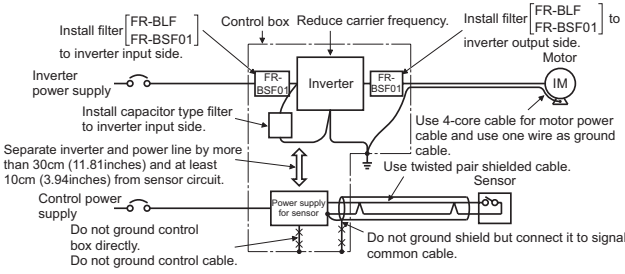


Noise Path	Measures
1), 2), 3)	When devices which handle low-level signals and are susceptible to misoperation due to noise (such as instruments, receivers and sensors) are installed near the inverter and their signal cables are contained in the same panel as the inverter or are run near the inverter, the devices may be misoperated by air-propagated noise and the following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Insert line noise filters onto I/O and capacitor type filters into inputs to suppress cable-radiated noises. (5) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.
4), 5), 6)	When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables causing misoperation of the devices and the following measures must be taken: (1) Install easily affected devices as far away as possible from the inverter. (2) Run easily affected signal cables as far away as possible from the inverter. (3) Do not run the signal cables and power cables (inverter I/O cables) in parallel with each other and do not bundle them. (4) Use shielded cables for signal cables and power cables and run them in individual metal conduits to further reduce effects.
7)	When the power supplies of the peripheral devices are connected to the power supply of the inverter within the same line, inverter-generated noise may flow back through the power supply cables causing misoperation of the devices and the following measures must be taken: (1) Install the capacitor type filter to the power cables (input cables) of the inverter. (2) Install the line noise filter (FR-BLF, FR-BSF01) to the power cables (I/O cables) of the inverter.
8)	When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage current may flow through the ground cable of the inverter causing misoperation of the device. In such a case, disconnection of the ground cable of the device may cause the device to operate properly.

● **Data line filter**

Noise entry can be prevented by providing a data line filter for the detector or other cable.

● **Example of counter measures against noise**


Install filter [FR-BLF FR-BSF01] to inverter input side.
Control box
Reduce carrier frequency.
Install filter [FR-BLF FR-BSF01] to inverter output side.
Motor
Inverter power supply
FR-BSF01
Inverter
FR-BSF01
IM
Install capacitor type filter to inverter input side.
Use 4-core cable for motor power cable and use one wire as ground cable.
Separate inverter and power line by more than 30cm (11.81inches) and at least 10cm (3.94inches) from sensor circuit.
Use twisted pair shielded cable.
Sensor
Control power supply
Power supply for sensor
Do not ground control box directly.
Do not ground control cable.
Do not ground shield but connect it to signal common cable.

2.3.3 Leakage currents and countermeasures

Due to the static capacitance existing in the inverter I/O wiring and motor, leakage currents flow through them. Since their values depend on the static capacitance, carrier frequency, etc., take the following measures.

(1) To-ground leakage currents

Leakage currents may flow not only into the inverter's own line but also into the other lines through the ground cable, etc. These leakage currents may operate ground leakage circuit breakers and ground leakage relays unnecessarily.

● Countermeasures

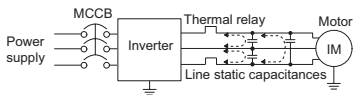
- If the carrier frequency setting is high, decrease the carrier frequency (Pr. 72) of the inverter.
  Note that motor noise increases. Selection of Soft-PWM (Pr. 240) will make it unoffending.
- By using ground leakage circuit breakers designed for harmonic and surge suppression in the inverter's own line and other line, operation can be performed with the carrier frequency kept high (with low noise).

● To-ground leakage current

- Note that a long wiring length will increase leakage currents. Decrease the carrier frequency of the inverter to reduce leakage currents.
- Higher motor capacity leads to larger leakage currents.

(2) Line-to-line leakage currents

Harmonics of leakage currents flowing in static capacities between the inverter output cables may operate the external thermal relay unnecessarily.



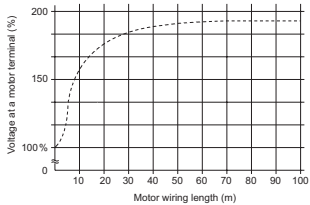
Line-to-line leakage current path

● **Countermeasures**

- Use the electronic thermal relay function of the inverter.
- Decrease the carrier frequency. Note that motor noise increases. Selection of Soft-PWM will make it unoffending.
  To ensure that the motor is protected not to be influenced by line-to-line leakage currents, we recommend the protection method which uses a temperature sensor to directly detect motor temperature.

2.3.4 Inverter-driven 575V class motor

In the PWM type inverter, a surge voltage attributable to wiring constants is generated at the motor terminals. Especially for a 575V class motor, the surge voltage may deteriorate the insulation.



Surge voltage at a motor terminal by motor wiring length (reference)

When the 575V class motor is driven by the inverter, consider the following measures:

● **Measures**

(1) Inverter duty motor

Select an inverter duty motor. Many motor manufacturers sell motors with insulation systems designed to withstand the stress imposed by PWM inverters.

(2) AC reactor

For added protection, install an AC reactor on the inverter output.

2.3.5 Peripheral devices

(1) Selection of peripheral devices

Check the capacity of the motor to be used with the inverter you purchased.
Appropriate peripheral devices must be selected according to the capacity.
Refer to the following list and prepare appropriate peripheral devices:

Inverter Type	Motor Output (kW) (HP)	Power Supply Capacity (kVA)	Moulded case circuit breaker (MCCB) or Ground Leakage Circuit Breaker (NV) (Note 5)		Magnetic Contactor (MC)
			Standard	With power factor improving reactor	
M4500E-001	0.75 (1)	2.5	5A	5A	3A
M4500E-002	1.5 (2)	4.5	10A	10A	5A
M4500E-003	2.2 (3)	5.5	15A	10A	7A
M4500E-005	3.7 (5)	9	20A	15A	10A
M4500E-007.5	5.5 (7.5)	12	30A	20A	15A
M4500E-010	7.5 (10)	17	30A	30A	21A

Note: 1. • Select the MCCB according to the inverter power supply capacity.
• Install one MCCB per inverter.

2. The power supply cable size of the motor indicated assumes that its length is 20m (65.62 feet).
3. When the inverter capacity is greater than the motor capacity, choose the breaker and magnetic contactor in accordance with the inverter type and choose the cables and power factor improving reactor in accordance with the motor output.
4. When the breaker on the inverter primary side trips, check for the wiring fault (short circuit), damage to internal parts of the inverter, etc. Identify the cause of the trip, then remove the cause and power on the breaker.
5. For installations in the United States or Canada, the circuit breaker must be inverse time or instantaneous trip type.

● Installation and selection of moulded case circuit breaker

Install a moulded case circuit breaker (MCCB) in the power supply side for protection of the inverter's primary wiring. Refer to the previous table and choose the MCCB according to the inverter's power supply side power factor (which changes with the power supply voltage, output frequency and load). Especially for a completely electromagnetic type MCCB, the one with a larger capacity must be selected since its operational characteristics change with harmonic currents. (Check the data of the corresponding breaker for confirmation.) Also the ground leakage circuit breaker used should be durable against harmonics/surges.

2.3.6 Power off and magnetic contactor (MC)

(1) Inverter primary side magnetic contactor (MC)

On the inverter primary side, it is recommended to provide an MC for the following purposes. (Refer to page 41 for selection.)

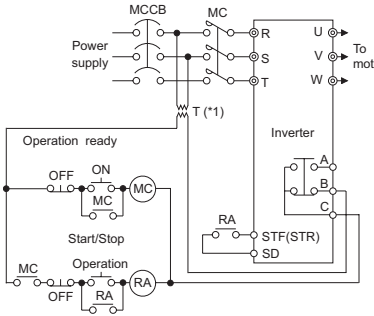
1) To release the inverter from the power supply when the inverter protective function is activated or the drive becomes faulty (e.g. emergency stop operation)
   When cycle operation or heavy-duty operation is performed with an optional brake resistor connected, overheat and burnout of the electrical-discharge resistor can be prevented if a regenerative brake transistor is damaged due to insufficient heat capacity of the electrical-discharge resistor and excess regenerative brake duty.
2) To prevent any accident due to an automatic restart at restoration of power after an inverter stop made by a power failure
3) To rest the inverter for an extended period of time
   The control power supply for inverter is always running and consumes a little power. When stopping the inverter for a long time, switching inverter power off saves power slightly.
4) To separate the inverter from the power supply to ensure safe maintenance and inspection work
   As the inverter's primary MC is used for the above purposes, select the one of class JEM1038-AC3 for the inverter input side current when making an emergency stop during normal operation.

REMARKS

The MC may be switched on/off to start/stop the inverter. However, since repeated inrush currents at power-on will shorten the life of the converter circuit (switching life is about 100,000 times), frequent starts and stops must be avoided.
Turn on/off the inverter start controlling terminals (STF, STR) to run/stop the inverter.

● **Inverter Start/Stop Circuit Example**

As shown on the right, always use the start signal (ON or OFF across terminals STF or STR-SD) to make a start or stop. (Refer to page 18.)



REMARKS

*1 Install a step-down transformer.

(2) Handling of secondary side magnetic contactor

Note that if it is switched off then on again during operation when the magnetic contactor is installed between the inverter and motor, a large inrush current may flow, affecting the motor.

2.3.7 Instructions for UL, cUL

(Standard to comply with: UL 508C, CSA C22.2 No. 14)

(1) Installation

The below types of inverter have been approved as products for use in enclosure and approval tests were conducted under the following conditions. Design the enclosure so that the ambient temperature, humidity and ambience of the inverter will satisfy the above specifications.

Branch circuit protection

For installation in United States, the Class K5 or equivalent for the branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes.

For installation in Canada, the Class K5 or equivalent for the branch circuit protection must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.

M4500E-□□□	001	002	003	005	007.5	010
Rated voltage (V)	600V or more					
Rated current (A)	6	10	15	20	30	40

(2) Wiring of the power supply and motor

Use the UL-listed cables (rated at 75°C (167°F)) and round crimping terminals to wire the input (R (L_1), S (L_2), T (L_3)) and output (U, V, W) terminals of the inverter. Crimp the terminals with the crimping tool recommended by the terminal manufacturer.

(3) Short circuit ratings

Suitable For Use in A Circuit Capable of Delivering Not More Than 65 kA rms Symmetrical Amperes, 632 V Maximum.

(4) Motor overload protection

When using the electronic thermal relay function as motor overload protection, set the rated motor current in Pr. 9 "electronic thermal O/L relay".

When connecting two or more motors to the inverter, install external thermal relays for individual motors

MEMO

CHAPTER 3
OPERATION/CONTROL

This chapter provides the basic "operation/control" for use of this product.
Always read this chapter before using the equipment.

3.1 Pre-Operation Information 46
3.2 About the Operation Panel 49
3.3 Operation 56

3.1 Pre-Operation Information

3.1.1 Types of operation modes

The inverter can be operated in any of "PU operation mode", "external operation mode", "combined operation mode" and "communication operation mode". Prepare required instruments and parts according to the operation mode. For the way of changing the operation mode, refer to page 52.

(1) External operation mode
(factory setting Pr. 79 "operation mode selection" = 0)

Pr. 79 "operation mode selection" is factory-set to 0 and the external operation mode is selected at power-on.

The inverter is operated using an external start signal and an external frequency setting signal.

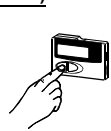
Preparation

- Start signal .....Switch, relay, etc.
- Frequency setting signal ..0 to 5V, 0 to 10V or 4 to 20mA DC signals or multiple speeds from a potentiometer or outside the inverter

Note: 1. Operation cannot be started by the start signal alone. Both the start signal and frequency setting signal are required to run the inverter.

(2) PU operation mode (Pr. 79 "operation mode selection" = 1)

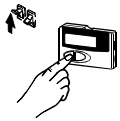
The inverter is operated using the optional operation panel or parameter unit.



Preparation

- Operation unit.....Operation panel (FR-PA02-02) or parameter unit (FR-PU04-MGI)
- Connection cable.....To be prepared for use of the operation panel (FR-PA02-02) away from the inverter or for use of the parameter unit (FR-PU04-MGI).
  FR-CB2□□ (option)
- FR-E5P (option) .....To be prepared for use of the operation panel away from the inverter. It is available as a set of operation panel cover and connection cable junction adaptor.

(3) Combined operation mode 1 (Pr. 79 "operation mode selection" = 3)

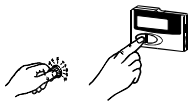


The start signal is an external signal.
The frequency setting signal is set using the optional operation panel or parameter unit.

Preparation

- Start signal ..... Switch, relay, etc.
- Operation unit ..... Operation panel (FR-PA02-02) or parameter unit (FR-PU04-MGI)
- Connection cable ..... Refer to (2) PU operation mode.
- FR-E5P (option) ..... Refer to (2) PU operation mode.

(4) Combined operation mode 2 (Pr. 79 "operation mode selection" = 4)



The start signal is entered from the operation command key of the optional operation panel.
The frequency setting signal is set using the external frequency setting signal.

Preparation

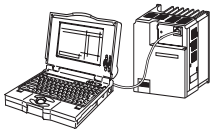
- Frequency setting signal .. 0 to 5V, 0 to 10V or 4 to 20mA DC signals from an external potentiometer or from outside the inverter
- Operation unit ..... Operation panel (FR-PA02-02) or parameter unit (FR-PU04-MGI)
- Connection cable ..... Refer to (2) PU operation mode.
- FR-E5P (option) ..... Refer to (2) PU operation mode.

(5) Communication operation mode
(Pr. 79 "operation mode selection" = 0 or 1)

Communication operation can be performed by connecting a personal computer and the PU connector with the RS-485 communication cable.

Preparation

- Connection cable..... Connector: RJ45 connector
  Cable: Cable conforming to EIA568
  (e.g. 10BASE-T cable)
- Personal computer ..... Refer to the instruction manual of the inverter setup software for hardware requirements of the inverter setup software.
- RS-485, RS-232C converter .... To be prepared when the communication port of the personal computer has RS-232C specifications.



3.1.2 Power on

Before switching power on, check the following.

● **Installation check**

Make sure that the inverter is installed correctly in a proper location. (Refer to page 14.)

● **Wiring check**

Make sure that the main and control circuits are wired correctly.
Make sure that the options and peripheral devices are selected and connected correctly. (Refer to page 16.)

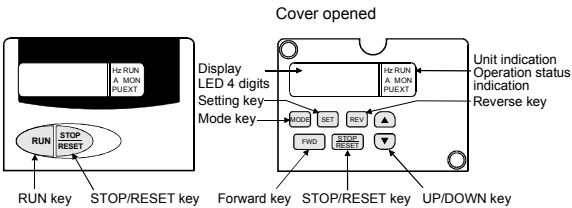
● **Switch power on.**

Power-on is complete if the POWER lamp is lit to give a correct indication and the ALARM lamp is off.

3.2 About the Operation Panel

With the optional operation panel (FR-PA02-02), you can run the inverter, set the frequency, monitor the operation command display, set parameters, and display an error.

3.2.1 Names and functions of the operation panel (FR-PA02-02)



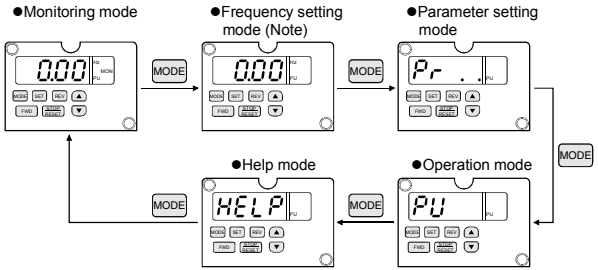
● **Key indication**

Key	Description
RUN key	Used to give a start rotation command.
MODE key	You can select the operation mode or setting mode.
SET key	You can determine the frequency and parameter setting.
▲/▼ key	• Used to increase or decrease the running frequency consecutively. Hold down this key to change the frequency. • Press this key in the setting mode to change the parameter setting consecutively.
FWD key	Used to give a forward rotation command.
REV key	Used to give a reverse rotation command.
STOP RESET key	• Used to stop operation. • Used to reset the inverter when its output is stopped by the activated protective function.

● **Unit indications, operating status indications**

Indication	Description
Hz	Lit to indicate frequency. (Flickers or lit when Pr.52 "operation panel/PU main display data selection" = "100". Refer to page 92.)
A	Lit to indicate the current.
RUN	Lit while the inverter is operating. Lit to indicate forward rotation, and flickers to indicate reverse rotation.
MON	Lit in the monitor display mode.
PU	Lit in the PU operation mode.
EXT	Lit in the external operation mode.

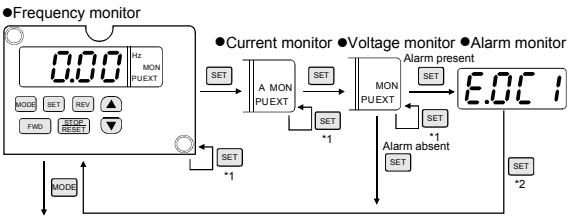
3.2.2 Monitor display is changed by pressing the MODE key



(Note)The frequency setting mode is displayed only in the PU operation mode.

3.2.3 Monitoring

- Operation command indications given while a monitor display is being provided EXT is lit to indicate external operation.
  PU is lit to indicate PU operation.
  Both EXT and PU are lit to indicate combined operation.
- The monitor display can also be changed during operation.

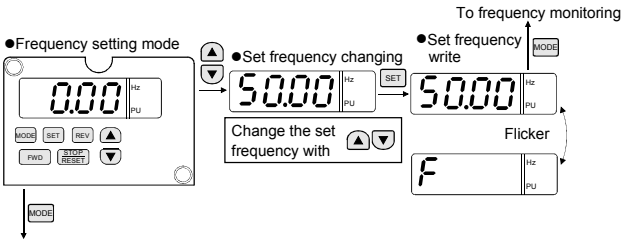


To 3.2.4 Frequency setting mode (Note3)

Note: 1. Hold down the SET key marked *1 for more than 1.5 s to change the current monitor to the power-on monitor.
2. Hold down the SET key marked *2 for more than 1.5 s to display the last four errors including the most recent one.
3. In the external operation mode, it shifts to the parameter setting mode.

3.2.4 Frequency setting

In the PU operation mode, set the frequency value used for operation performed under the operation command given by the RUN key (FWD or REV key).
This mode is displayed only in PU operation.



3.2.5 Parameter setting method

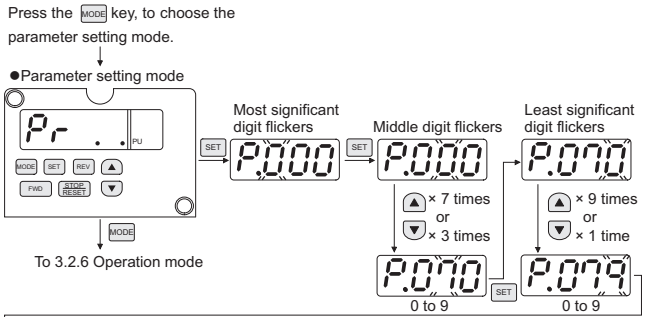
With the exception of some parameters, parameter setting can be made when the PU operation mode is selected by the Pr. 79 setting.
(Also, as other to set method independently of the operation mode, you can set "2" in Pr. 77. Refer to page 110.)

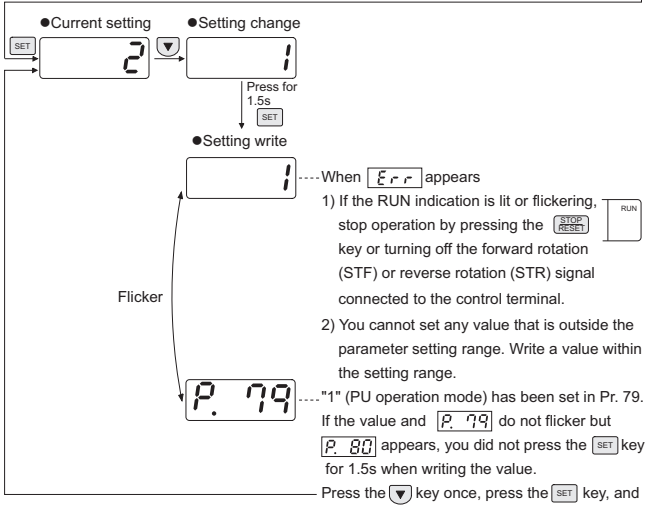
- A parameter value may either be set by updating its parameter number or setting the value digit-by-digit using the ▲/▼ key.
- To write the setting, change it and press the SET key for about 1.5 s.

Note: If parameter write cannot be performed, refer to page 176.

(1) Example:To change the Pr. 79 "operation mode selection" setting from "2" (external operation mode) to "1" (PU operation mode)

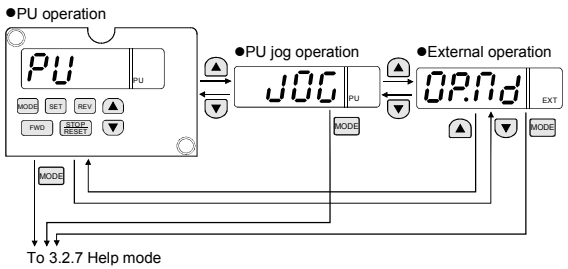
(For details of Pr. 79, refer to page 111.)




●Current setting
●Setting change
Press for 1.5s
SET
●Setting write
When Err appears
1) If the RUN indication is lit or flickering, stop operation by pressing the STOP RESET key or turning off the forward rotation (STF) or reverse rotation (STR) signal connected to the control terminal.
2) You cannot set any value that is outside the parameter setting range. Write a value within the setting range.
Flicker
"1" (PU operation mode) has been set in Pr. 79.
If the value and P. 79 do not flicker but P. 80 appears, you did not press the SET key for 1.5s when writing the value.
Press the ▼ key once, press the SET key, and restart the setting from the beginning.

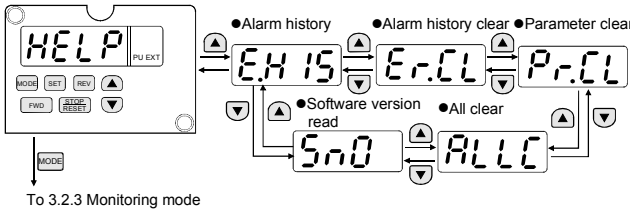
3.2.6 Operation mode

The operation mode change method which is shown below is only allowed when Pr. 79 "operation mode selection" is "0".



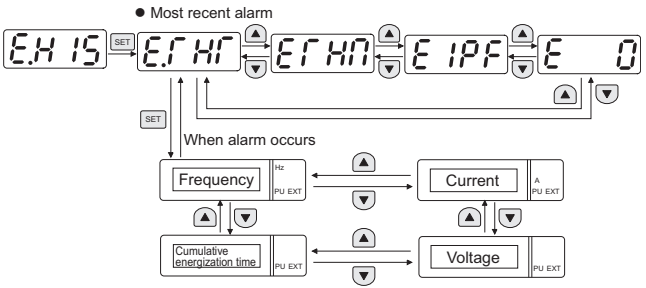
Note: If the operation mode cannot be changed, refer to page 176.

3.2.7 Help mode



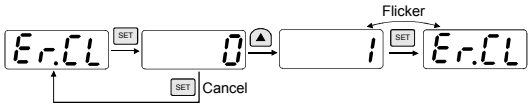
(1) Alarm history

Four past alarms can be displayed with the ▲/▼ key.
("." is appended to the most recent alarm.)
When no alarm exists, E._ _0 is displayed.



(2) Alarm history clear

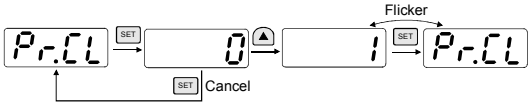
Clears all alarm history.



(3) Parameter clear

Initializes the parameter values to the factory settings. The calibration values are not initialized.

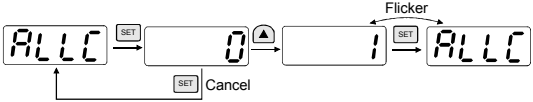
(Parameter values are not cleared by setting "1" in Pr. 77 "parameter write disable selection")



Note: The Pr. 75, Pr. 180 to Pr. 183, Pr. 190 to Pr. 192, and Pr.901 to Pr. 905 values are not initialized.

(4) All clear

Initializes the parameter values and calibration values to the factory settings.



Note: The Pr. 75 value is not initialized.

3

3.3 Operation

3.3.1 Pre-operation checks

Before starting operation, check the following:

- Safety
  Perform test operation after making sure that safety is ensured if the machine should become out of control.

- Machine
  Make sure that the machine is free of damage.

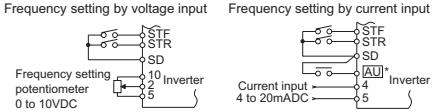
- Parameters
  Set the parameter values to match the operating machine (system) environment.

- Test operation
  Perform test operation and make sure that the machine operates safely under light load at a low frequency. After that, start operation.
  Since the Pr. 240 "Soft-PWM setting" value is factory-set to select Soft-PWM control, the tone is different from that in the conventional non-low acoustic noise mode, this is not a fault.

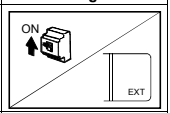
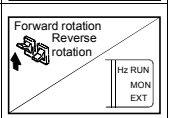
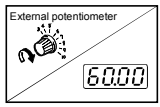
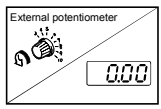
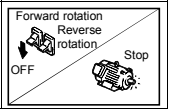
3.3.2 External operation mode (Operation using the external frequency setting potentiometer and external start signal)

(1) Operation at 60Hz

Operation command: Externally connected start signal
Frequency setting : Externally connected frequency setting potentiometer
<Connection diagram>



Refer to page 18 for details of each terminal.

Step	Description	Image
1	Power on → Operation mode check With the factory setting, the external operation mode is selected and the [EXT] indication is lit when power is switched on. If the [EXT] indication is not lit, refer to page 52 and set "2" in Pr. 79.	
2	Start Set the start switch (STF or STR) to ON. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation. Note: The motor does not start if both the forward and reverse rotation switches are turned on. If both switches are turned on during operation, the motor decelerates to a stop.	
3	Acceleration → Constant speed Slowly turn the potentiometer connected across terminals 2-5 (4-5) (frequency setting potentiometer) fully clockwise. The frequency shown on the display increases gradually to 60.00Hz.	
4	Deceleration Slowly turn the potentiometer connected across terminals 2-5 (4-5) (frequency setting potentiometer) fully counterclockwise. The frequency shown on the display decreases gradually to 0.00Hz. The motor stops running.	
5	Stop Turn off the start switch (STF or STR).	

<Reference> If other frequency is required at fully clockwise position, change Pr. 38 "frequency at 5V (10V)", Pr.39 "frequency at 20mA input" setting. (Refer to page 89.)

3.3.3 PU operation mode (Operation using the operation panel)

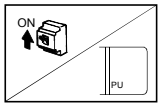
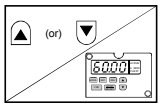
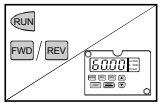
(1) Using the operation panel (FR-PA02-02) for operation at 60Hz with digital frequency setting

By repeating step 2 below during motor run, speed can be varied.

Operation command: RUN key or FWD / REV key of the operation panel (FR-PA02-02)

Frequency setting: ▲/▼ key

Related parameters:Pr. 79 "operation mode selection".

Step	Description	Image
1	Power on → Operation mode check Switch power on, refer to page 52, and set "1" in Pr. 79 "operation mode selection". The [PU] indication is lit.	
2	Running frequency setting Set the running frequency to 60Hz. 1) Refer to page 50 and choose the frequency setting mode using the MODE key. 2) Refer to page 51, change the setting using the ▲/▼ key, and press the SET key to write the setting.	
3	Start Press the RUN key (or FWD / REV key). The monitoring mode is automatically selected and the output frequency is displayed. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation.	
4	Stop Press the STOP RESET key. The motor is decelerated to a stop. The [RUN] indication goes off.	

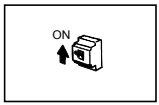
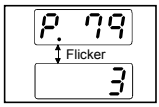
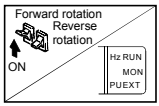
(2) PU jog operation

Hold down the RUN (or FWD or REV) key to perform operation, and release it to stop.

1) Set Pr. 15 "jog frequency" and Pr. 16 "jog acceleration/deceleration time".
2) Select the PU jog operation mode. (Refer to page 53.)
3) Hold down the RUN (or FWD or REV) key to perform operation.
   (If the motor remains stopped, check Pr. 13 "starting frequency". The motor will not start if its setting is lower than the starting frequency.

3.3.4 Combined operation mode 1 (Operation using both external start signal and operation panel)

When the start signal is provided externally (switch, relay, etc.) and the running frequency is set from the operation panel (Pr. 79 = 3).
The external frequency setting signal and PU's forward rotation, reverse rotation and stop keys are not accepted. (Note)
Operation command: externally connected start signal
Frequency setting: (▲)/(▼) key of the operation panel (FR-PA02-02) or multi-speed command (multi-speed command has priority) (Refer to page 74)

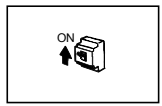
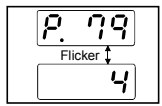
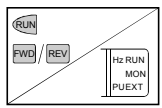
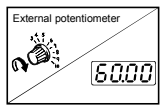
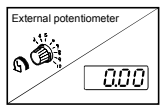
Step	Description	Image
1	Power on Switch power on.	
2	Operation mode selection Refer to page 52 and set "3" in Pr. 79 "operation mode selection". The [PU] and [EXT] indications are lit.	
3	Start Turn on the start switch (STF or STR). Note: The motor does not start if both the forward and reverse rotation switches are turned on. If both switches are turned on during operation, the motor decelerates to a stop. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation.	
4	Running frequency setting Set the running frequency to 60.00Hz with the (▲)/(▼) key.	
5	Stop Turn off the start switch (STF or STR). The motor stops. The [RUN] indication goes off.	

Note: The STOP RESET key is made valid if any of "14" to "17" is set in Pr. 75 "PU stop selection".

3.3.5 Combined operation mode 2

When the running frequency is set from a potentiometer connected across terminals 2-5 (frequency setting potentiometer) and the start signal is provided by the RUN key or FWD/REV key of the operation panel. (FR-PA02-02) (Pr.79 = 4)

Operation command: RUN key (or FWD/REV key) of the operation panel (FR-PA02-02)
Frequency setting: Externally connected frequency setting potentiometer or multi-speed command (multi-speed command has priority) (Refer to page 74).

Step	Description	Image
1	Power on Switch power on.	
2	Operation mode Refer to page 52 and set "4" in Pr. 79 "operation mode selection". The [PU] and [EXT] indications are lit.	
3	Start Press the RUN key (or FWD / REV key) of the operation panel. The [RUN] indication is lit to indicate forward rotation, or flickers to indicate reverse rotation.	
4	Acceleration → Constant speed Slowly turn the potentiometer connected across terminals 2-5 (frequency setting potentiometer) fully clockwise. The frequency shown on the display increases gradually to 60.00Hz.	
5	Deceleration Slowly turn the potentiometer connected across terminals 2-5 (frequency setting potentiometer) fully counterclockwise. The frequency shown on the display decreases gradually to 0.00Hz. The motor stops running.	
6	Stop Press the STOP/RESET key. The operation command indication RUN goes off.	

<Reference> If other frequency is required at fully clockwise position, change Pr. 38 "frequency at 5V (10V) " setting. (Refer to page 89.)

CHAPTER4 PARAMETERS

This chapter explains the "parameters" of this product.
With the factory settings, the inverter is designed to perform simple variable-speed operation. Set necessary parameter values according to the load and operating specifications.
Always read the instructions before using the equipment.

4.1 Parameter List 62
4.2 Parameter Function Details 71

Note: By making parameter setting, you can change the functions of contact input terminals RL, RM, RH, MRS, open collector output terminals RUN, FU, and contact output terminals A, B, C. Therefore, signal names corresponding to the functions are used in the description of this chapter (except in the wiring examples). Note that they are not terminal names.

4.1 Parameter List

4.1.1 Parameter list

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Basic functions	0	Torque boost (Note 1)	0 to 30%	0.1%	4%/3% (Note 4)	71	
	1	Maximum frequency	0 to 120Hz	0.01Hz (Note 3)	120Hz	72	
	2	Minimum frequency	0 to 120Hz	0.01Hz (Note 3)	0Hz	72	
	3	Base frequency (Note 1)	0 to 400Hz	0.01Hz (Note 3)	60Hz	73	
	4	Multi-speed setting (high speed)	0 to 400Hz	0.01Hz (Note 3)	60Hz	74	
	5	Multi-speed setting (middle speed)	0 to 400Hz	0.01Hz (Note 3)	30Hz	74	
	6	Multi-speed setting (low speed)	0 to 400Hz	0.01Hz (Note 3)	10Hz	74	
	7	Acceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/0.01 s	5 s/10s (Note 4)	75	
	8	Deceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/0.01 s	5 s/10s (Note 4)	75	
	9	Electronic thermal O/L relay	0 to 500A	0.01A	Rated output current (Note 5)	77	
Standard operation functions	10	DC injection brake operation frequency	0 to 120Hz	0.01Hz (Note 3)	3Hz	78	
	11	DC injection brake operation time	0 to 10 s	0.1 s	0.5 s	78	
	12	DC injection brake voltage	0 to 30%	0.1%	2%	78	
	13	Starting frequency	0 to 60Hz	0.01Hz	0.5Hz	79	
	14	Load pattern selection (Note 1)	0 to 3	1	0	80	
	15	Jog frequency	0 to 400Hz	0.01Hz (Note 3)	5Hz	81	
	16	Jog acceleration/ deceleration time	0 to 3600 s/ 0 to 360 s	0.1 s/ 0.01 s	0.5 s	81	
	18	High-speed maximum frequency	120 to 400Hz	0.01Hz (Note 3)	120Hz	72	
	19	Base frequency voltage (Note 1)	0 to 1000V, 8888, 9999	0.1V	9999	73	
	20	Acceleration/deceleration reference frequency	1 to 400Hz	0.01Hz (Note 3)	60Hz	75	
	21	Acceleration/deceleration time increments	0, 1	1	0	75	
	22	Stall prevention operation level	0 to 200%	0.1%	150%	82	
	23	Stall prevention operation level compensation factor at double speed (Note 6)	0 to 200%, 9999	0.1%	9999	82	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Standard operation functions	24	Multi-speed setting (speed 4)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	25	Multi-speed setting (speed 5)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	26	Multi-speed setting (speed 6)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	27	Multi-speed setting (speed 7)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	29	Acceleration/deceleration pattern	0, 1, 2	1	0	85	
	30	Regenerative function selection	0, 1	1	0	86	
	31	Frequency jump 1A	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	87	
	32	Frequency jump 1B	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	87	
	33	Frequency jump 2A	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	87	
	34	Frequency jump 2B	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	87	
	35	Frequency jump 3A	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	87	
	36	Frequency jump 3B	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	87	
	37	Speed display	0, 0.01 to 9998	0.001 r/min	0	88	
	38	Frequency at 5V (10V) input	1 to 400Hz	0.01Hz (Note 3)	60Hz (Note 2)	89	
	39	Frequency at 20mA input	1 to 400Hz	0.01Hz (Note 3)	60Hz (Note 2)	89	
Output terminal functions	41	Up-to-frequency sensitivity	0 to 100%	0.1%	10%	90	
	42	Output frequency detection	0 to 400Hz	0.01Hz (Note 3)	6Hz	91	
	43	Output frequency detection for reverse rotation	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	91	
Second functions	44	Second acceleration/ deceleration time	0 to 3600 s /0 to 360 s	0.1 s/0.01 s	5s/10s (Note 4)	75	
	45	Second deceleration time	0 to 3600 s /0 to 360 s, 9999	0.1 s/0.01 s	9999	75	
	46	Second torque boost (Note 1)	0 to 30%, 9999	0.1%	9999	71	
	47	Second V/F (base frequency) (Note 1)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	73	
	48	Second electronic thermal O/L relay	0 to 500A, 9999	0.01A	9999	77	
Display functions	52	Operation panel/PU main display data selection	0, 23, 100	1	0	92	
	55	Frequency monitoring reference	0 to 400Hz	0.01Hz (Note 3)	60Hz	94	
	56	Current monitoring reference	0 to 500A	0.01A	Rated output current	94	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Automatic restart functions	57	Restart coasting time	0 to 5 s, 9999	0.1s	9999	95	
	58	Restart cushion time	0 to 60 s	0.1s	1.0 s	95	
Additional function	59	Remote setting function selection	0, 1, 2	1	0	97	
Operation selection functions	60	Shortest acceleration/ deceleration mode	0, 1, 2, 11, 12	1	0	100	
	61	Reference current	0 to 500A, 9999	0.01A	9999	100	
	62	Reference current for acceleration	0 to 200%, 9999	1%	9999	100	
	63	Reference current for deceleration	0 to 200%, 9999	1%	9999	100	
	65	Retry selection	0, 1, 2, 3	1	0	102	
	66	Stall prevention operation level reduction starting frequency (Note 6)	0 to 400Hz	0.01Hz (Note 3)	60Hz	82	
	67	Number of retries at alarm occurrence	0 to 10, 101 to 110	1	0	102	
	68	Retry waiting time	0.1 to 360 s	0.1s	1 s	102	
	69	Retry count display erasure	0	1	0	102	
	70	Special regenerative brake duty	0 to 30%	0.1%	0%	86	
	71	Applied motor (Note 6)	0, 1, 3, 5, 6, 13, 15, 16, 23, 100, 101, 103, 105, 106, 113, 115, 116, 123,	1	0	104	
	72	PWM frequency selection	0 to 15	1	1	105	
	73	0-5V/0-10V selection	0, 1, 10, 11, (Note 8)	1	0	106	
	74	Filter time constant	0 to 8	1	1	107	
	75	Reset selection/ disconnected PU detection/ PU stop selection	0 to 3, 14 to 17	1	14	108	
	77	Parameter write disable selection	0, 1, 2	1	0	110	
	78	Reverse rotation prevention selection	0, 1, 2	1	0	111	
	79	Operation mode selection (Note 6)	0 to 4, 6 to 8	1	0	111	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
General-purpose magnetic flux vector control	80	Motor capacity (Note 6)	0.4 to 7.5kW, 9999	0.01kW	9999	115	
	82	Motor excitation current	0 to 500A, 9999	0.01A	9999	116	
	83	Rated motor voltage (Note 6)	0 to 1000V	0.1V	575V	116	
	84	Rated motor frequency (Note 6)	50 to 120Hz	0.01Hz (Note 3)	60Hz	116	
	90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999	116	
	96	Auto-tuning setting/status (Note 6)	0, 1	1	0	116	
Communication functions	117	Communication station number	0 to 31	1	0	122	
	118	Communication speed	48, 96, 192	1	192	122	
	119	Stop bit length	0, 1 (data length 8) 10, 11 (data length 7)	1	1	122	
	120	Parity check presence/absence	0, 1, 2	1	2	122	
	121	Number of communication retries	0 to 10, 9999	1	1	122	
	122	Communication check time interval	0, 0.1 to 999.8 s, 9999	0.1s	9999	122	
	123	Waiting time setting	0 to 150, 9999	1	9999	122	
	124	CR • LF presence/absence selection	0, 1, 2	1	1	122	
PID control	128	PID action selection	0, 20, 21, 50,51,60,61	1	0	135	
	129	PID proportional band	0.1 to 1000%, 9999	0.1%	100%	135	
	130	PID integral time	0.1 to 3600 s, 9999	0.1 s	1 s	135	
	131	Upper limit	0 to 100%, 9999	0.1%	9999	135	
	132	Lower limit	0 to 100%, 9999	0.1%	9999	135	
	133	PID action set point for PU operation	0 to 100%	0.01%	0%	135	
	134	PID differential time	0.01 to 10.00 s, 9999	0.01 s	9999	135	
Additional function	145	Parameter for option (FR-PU04-MGI).					
	146	Parameter set by manufacturer. Do not set.					
Current detection	150	Output current detection level	0 to 200%	0.1%	150%	143	
	151	Output current detection period	0 to 10 s	0.1 s	0	143	
	152	Zero current detection level	0 to 200.0%	0.1%	5.0%	144	
	153	Zero current detection period	0.05 to 1 s	0.01 s	0.5 s	144	

Function	Parameter Number	Name	Setting Range	Minimum Setting Increments	Factory Setting	Refer To:	Customer Setting
Sub function	156	Stall prevention operation selection	0 to 31,100	1	0	82	
	158	AM terminal function selection (Note 9)	0, 1, 2	1	0	92	
Additional function	160	User group read selection	0, 1, 10, 11	1	0	145	
	168	Parameters set by manufacturer. Do not set.					
	169						
Initial monitor	171	Actual operation hour meter clear	0	———	0	147	
User functions	173	User group 1 registration	0 to 999	1	0	145	
	174	User group 1 deletion	0 to 999, 9999	1	0	145	
	175	User group 2 registration	0 to 999	1	0	145	
	176	User group 2 deletion	0 to 999, 9999	1	0	145	
Terminal assignment functions	180	RL terminal function selection (Note 6)	0 to 8, 16, 18	1	0	147	
	181	RM terminal function selection (Note 6)	0 to 8, 16, 18	1	1	147	
	182	RH terminal function selection (Note 6)	0 to 8, 16, 18	1	2	147	
	183	MRS terminal function selection (Note 6)	0 to 8, 16, 18	1	6	147	
	190	RUN terminal function selection (Note 6)	0 to 99	1	0	149	
	191	FU terminal function selection (Note 6)	0 to 99	1	4	149	
	192	A, B, C terminal function selection (Note 6)	0 to 99	1	99	149	
Multi-speed operation	232	Multi-speed setting (speed 8)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	233	Multi-speed setting (speed 9)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	234	Multi-speed setting (speed 10)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	235	Multi-speed setting (speed 11)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	236	Multi-speed setting (speed 12)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	237	Multi-speed setting (speed 13)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	238	Multi-speed setting (speed 14)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	
	239	Multi-speed setting (speed 15)	0 to 400Hz, 9999	0.01Hz (Note 3)	9999	74	

Function	Parameter Number	Name	Setting Range		Minimum Setting Increments	Factory Setting		Refer To:	Customer Setting
Sub functions	240	Soft-PWM setting	0, 1		1	1		105	
	244	Cooling fan operation selection	0, 1		1	0		150	
	245	Rated motor slip	0 to 50%, 9999		0.01%	9999		151	
	246	Slip compensation response time	0.01 to 10 s		0.01 s	0.5 s		151	
	247	Constant-output region slip compensation selection	0, 9999		1	9999		151	
Stop selection function	250	Stop selection	0 to 100 s, 1000 to 1100 s, 8888, 9999		1	9999		152	
Additional function	251	Output phase failure protection selection	0, 1		1	1		153	
	254	Analog polarity reversible lower limit (Note 9)	0 to 100%, 9999		0.1%	9999		106	
	342	E^2PROM write selection	0, 1		1	0		122	
Calibration functions	901	AM terminal calibration	——		——	——		154	
	902	Frequency setting voltage bias	0 to 10V	0 to 60Hz	0.01Hz	0V	0Hz	156	
	903	Frequency setting voltage gain	0 to 10V	1 to 400Hz	0.01Hz	5V	60 Hz	156	
	904	Frequency setting current bias	0 to 20mA	0 to 60Hz	0.01Hz	4 mA	0Hz	156	
	905	Frequency setting current gain	0 to 20mA	1 to 400Hz	0.01Hz	20 mA	60 Hz	156	
	990	Parameter for options (FR-PU04-MGI).							
	991								

Note: 1. Indicates the parameter of which setting is ignored when the general-purpose magnetic flux vector control mode is selected.
2. Since calibration is made before shipment from the factory, the settings differ slightly between inverters. The inverter is preset to provide a frequency slightly higher than 60Hz.
3. When the operation panel is used and the setting is 100Hz or more, the setting increments are 0.1Hz.
   The setting increments are 0.01Hz when operating in the communication mode.
4. The setting varies according to the inverter capacity: (001 to 005)/(007.5, 010).
5. 001 is set to 85% of the rated inverter current.
6. If "2" is set in Pr. 77 (parameter write disable selection), the setting cannot be changed during operation.
7. The shaded parameters allow their settings to be changed during operation if "0" (factory setting) has been set in Pr. 77 (parameter write disable selection). (However, the Pr. 72 and Pr. 240 values may be changed during PU operation only.)
8. To set "10" or "11" in Pr. 73, first "801" must set in Pr. 77.
9. When setting Pr. 254, set "801" in Pr. 77.

4.1.2 List of parameters classified by purpose of use

Set the parameters according to the operating conditions. The following list indicates purpose of use and corresponding parameters.

Purpose of Use		Parameter Numbers
		Parameter numbers which must be set
Related to operation	Operation mode selection	Pr. 79
	Acceleration/deceleration time/pattern adjustment	Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 29
	Selection of output characteristics optimum for load characteristics	Pr. 3, Pr. 14, Pr. 19
	Output frequency restriction (limit)	Pr. 1, Pr. 2, Pr. 18
	Operation over 60Hz	Pr. 1, Pr. 18, Pr. 38, Pr. 39, Pr. 903, Pr. 905
	Adjustment of frequency setting signals and outputs	Pr. 38, Pr. 39, Pr. 73, Pr. 254, Pr. 902 to Pr. 905
	Motor output torque adjustment	Pr. 0, Pr. 80
	Brake operation adjustment	Pr. 10, Pr. 11, Pr. 12
	Multi-speed operation	Pr. 1, Pr. 2, Pr. 4, Pr. 5, Pr. 6, Pr. 15, Pr. 24, Pr. 25, Pr. 26, Pr. 27, Pr. 232, Pr. 233, Pr. 234, Pr. 235, Pr. 236, Pr. 237, Pr. 238, Pr. 239
	Jog operation	Pr. 15, Pr. 16
	Frequency jump operation	Pr. 31, Pr. 32, Pr. 33, Pr. 34, Pr. 35, Pr. 36
	Automatic restart operation after instantaneous power failure	Pr. 57, Pr. 58
	Optimum acceleration/deceleration within continuous rated range	Pr. 60
	Slip compensation setting	Pr. 245 to Pr. 247
	Output stop method selection	Pr. 250
	Setting of output characteristics matching the motor	Pr. 3, Pr. 19, Pr. 71
	Stall prevention of motor, lift operation	Pr. 156
Related to application operation	General-purpose magnetic flux vector control operation	Pr. 80
	Electromagnetic brake operation timing	Pr. 42, Pr. 190 to Pr. 192
	Offline auto tuning setting	Pr. 82 to Pr. 84, Pr. 90, Pr. 96
	Sub-motor operation	Pr. 0, Pr. 3, Pr. 7, Pr. 8, Pr. 9, Pr. 44, Pr. 45, Pr. 46, Pr. 47, Pr. 48
	Regenerative function selection	Pr. 30, Pr. 70
	Operation in communication with personal computer	Pr. 117 to Pr. 124, Pr. 342
	Operation under PID control	Pr. 73, Pr. 79, Pr. 128 to Pr. 134, Pr. 180 to Pr. 183, Pr. 190 to Pr. 192
	Noise reduction	Pr. 72, Pr. 240

Purpose of Use		Parameter Numbers
		Parameter numbers which must be set
Related to monitoring	Frequency meter calibration	Pr. 55, Pr. 56, Pr. 158, Pr. 901
	Display of monitor on operation panel (FR-PA02-02) or parameter unit (FR-PU04-MGI)	Pr. 55, Pr. 56, Pr. 158, Pr. 901
	Display of speed, etc.	Pr. 37, Pr. 52
	Clearing of inverter's actual operation time	Pr. 171
Related to incorrect operation prevention	Function write prevention	Pr. 77
	Reverse rotation prevention	Pr. 78
	Parameter grouping	Pr. 160, Pr. 173 to Pr. 176
	Current detection	Pr. 150 to Pr. 153, Pr. 190 to Pr. 192
	Motor stall prevention	Pr. 22, Pr. 23, Pr. 66, Pr. 156
Others	Input terminal function assignment	Pr. 180 to Pr. 183
	Output terminal function assignment	Pr. 190 to Pr. 192
	Increased cooling fan life	Pr. 244
	Motor protection from overheat	Pr. 9, Pr. 71
	Automatic restart operation at alarm stop	Pr. 65, Pr. 67, Pr. 68, Pr. 69
	Inverter reset selection	Pr. 75
	Output phase failure protection selection	Pr. 251

4.1.3 Parameters recommended to be set by the user

We recommend the following parameters to be set by the user.
Set them according to the operation specifications, load, etc.

Parameter Number	Name	Application
1	Maximum frequency	Used to set the maximum and minimum output frequencies.
2	Minimum frequency	
7	Acceleration time	Used to set the acceleration and deceleration times.
8	Deceleration time	
9	Electronic thermal O/L relay	Used to set the current of the electronic overcurrent protection to protect the motor from overheat.
14	Load pattern selection	Used to select the optimum output characteristics which match the application and load characteristics.
71	Applied motor	Used to set the thermal characteristics of the electronic overcurrent protection according to the motor used.
73	0-5V/0-10V selection	Used to select the specifications of the frequency setting signal entered across terminal 2-5 to perform operation with the voltage input signal.
156	Stall prevention operation selection	In vertical lift applications, make setting so that the high-response current limit is not activated. When high response current restriction is activated, torque may not be produced, causing a gravity drop.
901	AM terminal calibration	Used to calibrate the meter connected across terminals AM-5.
902	Frequency setting voltage bias	Used to set the magnitude (slope) of the output frequency relative to the frequency setting signal (0 to 5V, 0 to 10V or 4 to 20mA DC) as desired.
903	Frequency setting voltage gain	
904	Frequency setting current bias	
905	Frequency setting current gain	

4.2 Parameter Function Details

4.2.1 Torque boost (Pr. 0, Pr. 46)

Pr. 0 "torque boost"

Pr. 46 "second torque boost"

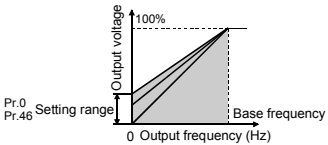
Related parameters

Pr. 3 "base frequency"
Pr. 19 "base frequency voltage"
Pr. 71 "applied motor"
Pr. 80 "motor capacity"
Pr. 180 to Pr. 183 (input terminal function selection)

Increase the setting when the inverter-to-motor distance is long or motor torque in the low-speed range is insufficient, for example;

- Motor torque in the low-frequency range can be adjusted to the load to increase the starting motor torque.
- You can select either of the two starting torque boosts by RT terminal switching.

Parameter Number	Factory Setting		Setting Range	Remarks
0	001 to 005	4%	0 to 30%	
	007.5, 010	3%		
46	9999		0 to 30%, 9999	9999: Function invalid



<Setting>

- Assuming that the base frequency voltage is 100%, set the 0Hz voltage in %.
- Pr. 46 "second torque boost" is valid when the RT signal is on. (Note 3)

Note: 1. This parameter setting is ignored when the general-purpose magnetic flux vector control mode has been selected.
2. A large setting may result in an overheated motor or overcurrent trip. The guideline for the largest value for this parameter is about 10%.
3. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 147 for Pr. 180 to Pr. 183 (input terminal function selection).

4.2.2 Output frequency range (Pr. 1, Pr. 2, Pr. 18)

Pr. 1 "maximum frequency"

Pr. 2 "minimum frequency"

Pr. 18 "high-speed maximum frequency"

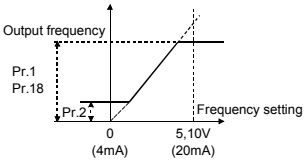
Related parameters

Pr. 13 "starting frequency"
Pr. 38 "frequency at 5V (10V) input"
Pr. 39 "frequency at 20mA input"
Pr. 79 "operation mode selection"

Used to clamp the upper and lower limits of the output frequency. Used for high-speed operation at or over 120Hz.

- Can be used to set the upper and lower limits of motor speed.

Parameter Number	Factory Setting	Setting Range
1	120Hz	0 to 120Hz
2	0Hz	0 to 120Hz
18	120Hz	120 to 400Hz



<Setting>

- Use Pr. 1 to set the upper limit of the output frequency. If the frequency of the frequency command entered is higher than the setting, the output frequency is clamped at the maximum frequency.
- To perform operation over 120Hz, set the upper limit of the output frequency in Pr. 18. (When the Pr. 18 value is set, Pr. 1 automatically changes to the frequency in Pr. 18. Also, when the Pr. 1 value is set, Pr. 18 automatically changes to the frequency in Pr. 1.)
- Use Pr. 2 to set the lower limit of the output frequency.

Note: When the potentiometer (frequency setting potentiometer) connected across terminals 2-5 is used for operation beyond 60Hz, change the value of Pr. 38 (or Pr. 39 for use of the potentiometer connected across terminals 4-5).
Operation over 60Hz cannot be performed by merely changing the settings of Pr. 1 and Pr. 18.

⚠ CAUTION

⚠ **If the Pr. 2 setting is higher than the Pr. 13 "starting frequency" value, note that the motor will run at the set frequency according to the acceleration time setting by merely switching the start signal on, without entry of the command frequency.**

4.2.3 Base frequency, base frequency voltage (Pr. 3, Pr. 19, Pr. 47)

Pr. 3 "base frequency"

Pr. 19 "base frequency voltage"

Pr. 47 "second V/F(base frequency)

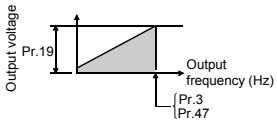
Related parameters

Pr. 14 "load pattern selection"
Pr. 71 "applied motor"
Pr. 80 "motor capacity"
Pr. 83 "rated motor voltage"
Pr. 180 to Pr. 183 (input terminal function selection)

Used to adjust the inverter outputs (voltage, frequency) to the motor rating.

- When running a standard motor, generally set the rated motor frequency. When running the motor using the commercial power supply-inverter switch-over, set the base frequency to the same value as the power supply frequency.
- If the frequency given on the motor rating plate is "50Hz" only, always set to "50Hz". Leaving it as "60Hz" may make the voltage too low and the torque less, resulting in overload tripping. Care must be taken especially when Pr. 14 "load pattern selection = 1.

Parameter Number	Factory Setting	Setting Range	Remarks
3	60Hz	0 to 400Hz	
19	9999	0 to 1000V, 8888, 9999	8888: 95% of power supply voltage 9999: Same as power supply voltage
47	9999	0 to 400Hz, 9999	9999: Function invalid



<Setting>

- Use Pr. 3 and Pr. 47 to set the base frequency (rated motor frequency). Two base frequencies can be set and the required frequency can be selected from them.
- Pr. 47 "second V/F (base frequency)" is valid when the RT signal is on. (Note 3)
- Use Pr. 19 to set the base voltage (e.g. rated motor voltage).

Note: 1. Set 60Hz in Pr. 3 "base frequency" when using a constant-torque motor.
2. When the general-purpose magnetic flux vector control mode has been selected, Pr. 3, Pr. 19 and Pr. 47 are made invalid and Pr. 83 and Pr. 84 are made valid.
However, Pr. 3 or Pr. 47 is made valid for the S-shaped inflection pattern point of Pr. 29.
3. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 147 for Pr. 180 to Pr. 183 (input terminal function selection).

4.2.4 Multi-speed operation (Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239)

Pr. 4 "multi-speed setting (high speed)"

Pr. 5 "multi-speed setting (middle speed)"

Pr. 6 "multi-speed setting (low speed)"

Pr. 24 to Pr. 27 "multi-speed setting (speeds 4 to 7)"

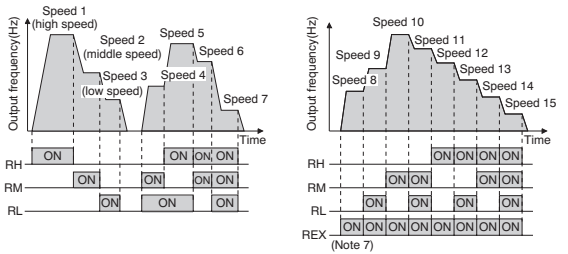
Pr. 232 to Pr. 239 "multi-speed setting (speeds 8 to 15)"

Related parameters
Pr. 1 "maximum frequency"
Pr. 2 "minimum frequency"
Pr. 29 "acceleration/ deceleration pattern"
Pr. 79 "operation mode selection"
Pr. 180 to Pr. 183 (input terminal function selection)

Used to switch between the predetermined running speeds.

- Any speed can be selected by merely switching on/off the corresponding contact signals (RH, RM, RL, REX signals).
- By using these functions with Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency", up to 17 speeds can be set.
- Valid in the external operation mode or combined mode (Pr. 79 = 3 or 4)

Parameter Number	Factory Setting	Setting Range	Remarks
4	60Hz	0 to 400Hz	
5	30Hz	0 to 400Hz	
6	10Hz	0 to 400Hz	
24 to 27	9999	0 to 400Hz, 9999	9999: Not selected
232 to 239	9999	0 to 400Hz, 9999	9999: Not selected



<Setting>

- Set the running frequencies in the corresponding parameters.
- Each speed (frequency) can be set as desired between 0 and 400Hz during inverter operation.
  After the required multi-speed setting parameter has been read, the setting can be changed by pressing the (▲)/(▼) key. In this case, when you release the (▲)/(▼) key, press the SET key (WRITE key when using the parameter unit (FR-PU04-MGI)) to store the set frequency.
- Use any of Pr. 180 to Pr. 183 to assign the terminal used to input the REX signal.

Note: 1. The priorities of external terminal of the frequency command are in order of jog, multi-speed, terminal 4 and terminal 2.
2. The multi-speeds can also be set in the PU or external operation mode.
3. For 3-speed setting, if two or three speeds are simultaneously selected, priority is given to the frequency setting of the lower signal.
4. Pr. 24 to Pr. 27 and Pr. 232 to Pr. 239 settings have no priority between them.
5. The parameter values can be changed during operation.
6. When input terminal assignment is changed using Pr. 180 to Pr. 183, other functions may be affected. Check the functions of the corresponding terminals before making setting.
7. When only the REX signal is on with "9999" set in Pr.232, the set frequency is changed to 0Hz.

4.2.5 Acceleration/deceleration time (Pr. 7, Pr. 8, Pr. 20, Pr. 21, Pr. 44, Pr. 45)

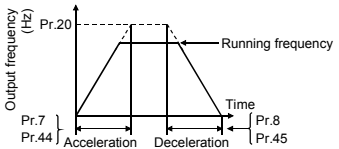
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 20 "acceleration/deceleration reference frequency"

Related parameters
Pr. 3 "base frequency"
Pr. 29 "acceleration/deceleration pattern"

Pr. 21 "acceleration/deceleration time increments"
Pr. 44 "second acceleration/deceleration time"
Pr. 45 "second deceleration time"

Used to set motor acceleration/deceleration time.
Set a larger value for a slower speed increase/decrease or a smaller value for a faster speed increase/decrease.

Parameter Number	Factory Setting		Setting Range	Remarks
7	001 to 005	5s	0 to 3600s/0 to 360s	
	007.5, 010	10s		
8	001 to 005	5s	0 to 3600s/0 to 360s	
	007.5, 010	10s		
20	60Hz		1 to 400Hz	
21	0		0, 1	0: 0 to 3600s 1: 0 to 360s
44	001 to 005	5s	0 to 3600s/0 to 360s	
	007.5, 010	10s		
45	9999		0 to 3600s/ 0 to 360s, 9999	9999: acceleration time = deceleration time



<Setting>

- Use Pr. 21 to set the acceleration/deceleration time and minimum setting increments:
  Set value "0" (factory setting).....0 to 3600s (minimum setting increments: 0.1s)
  Set value "1".....0 to 360s (minimum setting increments: 0.01s)
- When you have changed the Pr. 21 setting, set the deceleration time again. (Note 5)
- Use Pr. 7 and Pr. 44 to set the acceleration time required to reach the frequency set in Pr. 20 from 0Hz.
- Use Pr. 8 and Pr. 45 to set the deceleration time required to reach 0Hz from the frequency set in Pr. 20.
- Pr. 44 and Pr. 45 are valid when the RT signal is on. When the RT signal is on, the other second functions such as second torque boost are also selected.
- Set "9999" in Pr. 45 to make the deceleration time equal to the acceleration time (Pr. 44).

Note: 1. In S-shaped acceleration/deceleration pattern A (refer to page 85), the set time is the period required to reach the base frequency set in Pr. 3.

•Acceleration/deceleration time formula when the set frequency is the base frequency or higher

$$t = \frac{4}{9} \times \frac{T}{(Pr.\ 3)^2} \times f^2 + \frac{5}{9} T$$

T: Acceleration/deceleration time setting (s)
f : Set frequency (Hz)

•Guideline for acceleration/deceleration time at the base frequency of 60Hz (0Hz to set frequency)

Frequency setting (Hz) / Acceleration/ deceleration time (s)	60	120	200	400
5	5	12	27	102
15	15	35	82	305

2. If the Pr. 20 setting is changed, the settings of calibration functions Pr. 903 and Pr. 905 (frequency setting signal gains) remain unchanged.
   To adjust the gains, adjust calibration functions Pr. 903 and Pr. 905.
3. When the setting of Pr. 7, Pr. 8, Pr. 44 or Pr. 45 is 0.03s or less, the acceleration/deceleration time is 0.04s. At this time, set 120Hz or less in Pr. 20.
4. If the shortest acceleration/deceleration time is set, the actual motor acceleration/deceleration time cannot be made shorter than the shortest acceleration/deceleration time determined by the mechanical system's J (inertia moment) and motor torque.
5. Changing the Pr. 21 setting changes the acceleration/deceleration setting (Pr. 7, Pr. 8, Pr. 16, Pr. 44, Pr. 45).
   <Example>
   When Pr. 21 = "0" and the setting of Pr. 7 = "5.0"s, and if the setting of Pr. 21 is changed to "1", the setting value of Pr. 7 will change to "0.5"s.

4.2.6 Electronic thermal relay function (Pr. 9, Pr. 48)

Pr. 9 "electronic thermal O/L relay

Pr. 48 "second electronic thermal O/L relay "

Related parameter
Pr. 71 "applied motor"
Pr. 180 to Pr. 183 (input terminal function selection)

Set the current of the electronic thermal relay function to protect the motor from overheat. This feature provides the optimum protective characteristics, including reduced motor cooling capability, at low speed.

Parameter Number	Factory Setting	Setting Range	Remarks
9	Rated output current*	0 to 500A	
48	9999	0 to 500A, 9999	9999: Function invalid

*001 is set to 85% of the rated inverter current.

<Setting>

- Set the rated current [A] of the motor. (Normally set the rated current at 50Hz if the motor has both 50Hz and 60Hz rated current.)
- Setting "0" makes the electronic thermal relay function (motor protective function) invalid. (The inverter's protective function is valid.)
- Set "1" in Pr.71 when using the constant torque motor. (This provides a 100% continuous torque characteristic in the low-speed region.) Then, set the rated motor current in Pr. 9.
- Pr. 48 "second electronic thermal O/L relay" is made valid when the RT signal is on. (Note 4)

Note: 1. When two or more motors are connected to the inverter, they cannot be protected by the electronic overcurrent protection. Install an external thermal relay to each motor.
2. When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic thermal relay function will be deteriorated. In this case, use an external thermal relay.
3. A special motor cannot be protected by the electronic thermal relay function. Use an external thermal relay.
4. The RT signal serves as the second function selection signal and makes the other second functions valid. Refer to page 147 for Pr. 180 to Pr. 183 (input terminal function selection).

4.2.7 DC injection brake (Pr. 10 to Pr. 12)

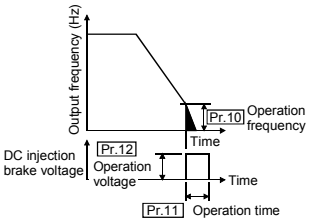
Pr. 10 "DC injection brake operation frequency"

Pr. 11 "DC injection brake operation time"

Pr. 12 "DC injection brake voltage"

By setting the DC injection brake voltage (torque), operation time and operation starting frequency, the stopping accuracy of positioning operation, etc. or the timing of operating the DC injection brake to stop the motor can be adjusted according to the load.

Parameter Number	Factory Setting	Setting Range
10	3Hz	0 to 120Hz
11	0.5s	0 to 10 s
12	2%	0 to 30%



<Setting>

- Use Pr. 10 to set the frequency at which the DC injection brake operation is started.
- Use Pr. 11 to set the period during when the brake is operated.
- Use Pr. 12 to set the percentage of the power supply voltage.

⚠ CAUTION

⚠ Install a mechanical brake. No holding torque is provided.

4.2.8 Starting frequency (Pr. 13)

Pr. 13 "starting frequency"

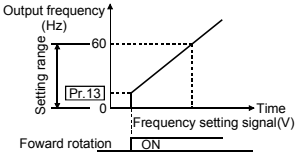
Related parameters

Pr. 2 "minimum frequency"

You can set the starting frequency between 0 and 60Hz.

- Set the starting frequency at which the start signal is switched on.

Parameter Number	Factory Setting	Setting Range
13	0.5Hz	0 to 60Hz



Note: The inverter will not start if the frequency setting signal is less than the value set in Pr. 13 "starting frequency".
For example, when 5Hz is set in Pr. 13, the motor will not start running until the frequency setting signal reaches 5Hz.

⚠ CAUTION

⚠ **When the Pr. 13 setting is equal to or less than the Pr. 2 "minimum frequency" value, note that merely switching on the start signal will start the motor at the preset frequency even if the command frequency is not input.**

4

4.2.9 Load pattern selection (Pr. 14)

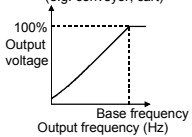
Pr. 14 "load pattern selection"

Related parameters
Pr. 0 "torque boost"
Pr. 46 "second torque boost"
Pr. 80 "motor capacity"
Pr. 180 to Pr. 183 (input terminal function selection)

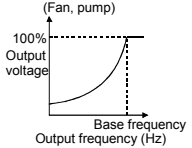
You can select the optimum output characteristic (V/F characteristic) for the application and load characteristics.

Parameter Number	Factory Setting	Setting Range
14	0	0 to 3

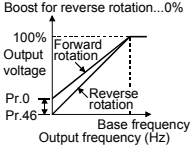
Pr.14=0
For constant-torque loads
(e.g. conveyor, cart)



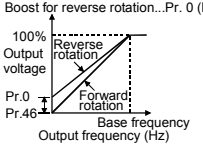
Pr.14=1
For variable-torque loads
(Fan, pump)



Pr.14=2
For lift
Boost for forward rotation...Pr. 0 (Pr.46) setting
Boost for reverse rotation...0%



Pr.14=3
For lift
Boost for forward rotation...0%
Boost for reverse rotation...Pr. 0 (Pr.46) setting



Note: 1. This parameter setting is ignored when the general-purpose magnetic flux vector control mode has been selected.
2. Pr. 46 "second torque boost" is made valid when the RT signal turns on.
The RT signal acts as the second function selection signal and makes the other second functions valid.
Refer to page 147 for Pr. 180 to Pr. 183 (input terminal function selection).

4.2.10 Jog operation (Pr. 15, Pr. 16)

Pr. 15 "jog frequency"

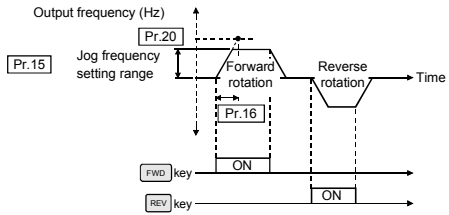
Pr. 16 "jog acceleration/ deceleration time"

Related parameters
Pr. 20 "acceleration/deceleration reference frequency"
Pr. 21 "acceleration/deceleration time increments"

Jog operation can be started and stopped by selecting the jog mode from the operation panel and pressing and releasing the RUN key (FWD, REV key).

- Set the frequency and acceleration/deceleration time for jog operation.

Parameter Number	Factory Setting	Setting Range	Remarks
15	5Hz	0 to 400Hz	
16	0.5s	0 to 3600 s	When Pr. 21 = 0
		0 to 360 s	When Pr. 21 = 1



Note: 1. In S-shaped acceleration/deceleration pattern A, the acceleration/deceleration time is the period of time required to reach Pr. 3 "base frequency", not Pr. 20.
2. The acceleration time and deceleration time cannot be set separately for jog operation.
3. The value set in Pr. 15 "jog frequency" should be equal to or greater than the Pr. 13 "starting frequency" setting.
4. When Pr. 79 Operation mode selection="4", pressing FWD/REV of the PU (FR-PA02-02, FR-PU04-MGI) starts the inverter and pressing STOP/RESET stops the inverter.

Pr. 18 ➔ Refer to Pr. 1, Pr. 2.

Pr. 19 ➔ Refer to Pr. 3.

Pr. 20, Pr. 21 ➔ Refer to Pr. 7, Pr. 8.

4.2.11 Stall prevention and current restriction (Pr. 22, Pr. 23, Pr. 66, Pr. 156)

Pr. 22 "stall prevention operation level"

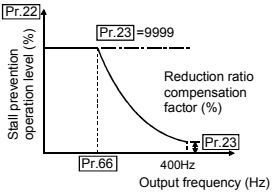
Pr. 23 "stall prevention operation level compensation factor at double speed"

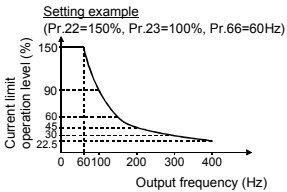
Pr. 66 "stall prevention operation level reduction starting frequency"

Pr. 156 "stall prevention operation selection"

- Stall prevention.....If the current exceeds the stall prevention operation level, the output frequency of the inverter is automatically varied to reduce the current.
- High-response current limit .....If the current exceeds the limit value, the output of the inverter is shut off to prevent an overcurrent.
- Set the output current level (% to the inverter rated current) at which the output frequency will be adjusted to prevent the inverter from stopping due to overcurrent etc.
- For high-speed operation at or over the motor base frequency, acceleration may not be made because the motor current does not increase.
  To improve the operation characteristics of the motor in such a case, the stall prevention level in the high-frequency range can be reduced. This is effective for operation of a centrifugal separator up to the high-speed range. Normally, set 60Hz in Pr. 66 and 100% in Pr. 23.
- For operation in the high-frequency range, the current in the locked motor state is smaller than the rated output current of the inverter and the inverter does not result in an alarm (protective function is not activated) if the motor is at a stop. To improve this and activate the alarm, the stall prevention level can be reduced.
- You can make setting to prevent stall caused by overcurrent and/or to prevent the inverter from resulting in an overcurrent trip (to disable high-response current restriction that limits the current) when an excessive current flows due to sudden load fluctuation or ON-OFF on the output side of a running inverter.

Parameter Number	Factory Setting	Setting Range	Remarks
22	150%	0 to 200%	
23	9999	0 to 200%, 9999	9999: Constant according to Pr. 22
66	60Hz	0 to 400Hz	
156	0	0 to 31, 100	





<Setting of stall prevention operation level>

- In Pr. 22, set the stall prevention operation level. Normally set it to 150% (factory setting). Set "0" in Pr. 22 to disable the stall prevention operation.
- To reduce the stall prevention operation level in the high-frequency range, set the reduction starting frequency in Pr. 66 and the reduction ratio compensation factor in Pr. 23.

Formula for stall prevention operation level

$$\text{Stall prevention operation level (\%)} = A + B \times \left[\frac{\text{Pr. 22-A}}{\text{Pr. 22-B}}\right] \times \left[\frac{\text{Pr. 23-100}}{100}\right]$$

$$\text{where, } A = \frac{\text{Pr. 66 (Hz)} \times \text{Pr. 22 (\%)}}{\text{output frequency (Hz)}}, \quad B = \frac{\text{Pr. 66 (Hz)} \times \text{Pr. 22 (\%)}}{400\text{Hz}}$$

- By setting "9999" (factory setting) in Pr. 23, the stall prevention operation level is constant at the Pr. 22 setting up to 400Hz.

<Setting of stall prevention operation selection>

Refer to the following table and set the parameter.

Pr. 156 Setting	High-Response Current Limit O: Activated ●: Not activated	Stall Prevention Operation Selection O: Activated ●: Not activated			OL Signal Output O: Operation continued ●: Operation not continued (Note 1)
		Acceleration	Constant speed	Deceleration	
0	O	O	O	O	O
1	●	O	O	O	O
2	O	●	O	O	O
3	●	●	O	O	O
4	O	O	●	O	O
5	●	O	●	O	O
6	O	●	●	O	O
7	●	●	●	O	O
8	O	O	O	●	O
9	●	O	O	●	O
10	O	●	O	●	O
11	●	●	O	●	O
12	O	O	●	●	O
13	●	O	●	●	O
14	O	●	●	●	O
15	●	●	●	●	O

Pr. 156 Setting		High-Response Current Limit O: Activated ●: Not activated	Stall Prevention Operation Selection O: Activated ●: Not activated			OL Signal Output O: Operation continued ●: Operation not continued (Note 1)
			Acceleration	Constant speed	Deceleration	
16		O	O	O	O	●
17		●	O	O	O	●
18		O	●	O	O	●
19		●	●	O	O	●
20		O	O	●	O	●
21		●	O	●	O	●
22		O	●	●	O	●
23		●	●	●	O	●
24		O	O	O	●	●
25		●	O	O	●	●
26		O	●	O	●	●
27		●	●	O	●	●
28		O	O	●	●	●
29		●	O	●	●	●
30		O	●	●	●	●
31		●	●	●	●	●
100	Driving	O	O	O	O	O
	Regenerative	●	●	●	●	O

Note: 1. When "Operation not continued for OL signal output" is selected using Pr.156, the "E.OLT" alarm code (stopped by stall prevention) is displayed and operation stopped.
(Alarm stop display "E.OLT")
2. If the load is heavy, the lift is predetermined, or the acceleration/deceleration time is short, the stall prevention may be activated and the motor not stopped in the preset acceleration/deceleration time. Therefore, set optimum values to the Pr. 156 and Pr. 22 (Pr. 23).
3. When the high-response current limit has been set in Pr. 156 (factory setting has the current limit activated), do not set the Pr. 22 value to 170% or more. Torque will not be developed by doing so.
4. In vertical lift applications, make setting so that the high-response current limit is not activated. Torque may not be produced, causing a gravity drop.

⚠ CAUTION

⚠ **Do not set a small value as the stall prevention operation current. Otherwise, torque generated will reduce.**

⚠ **Test operation must be performed.**
Stall prevention operation during acceleration may increase the acceleration time.
Stall prevention operation during constant speed may change the speed suddenly.
Stall prevention operation during deceleration may increase the deceleration time, increasing the deceleration distance.

Pr. 24 to Pr. 27 ➔Refer to Pr. 4 to Pr. 6.

4.2.12 Acceleration/deceleration pattern (Pr. 29)

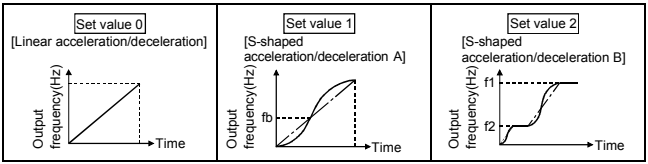
Pr. 29 "acceleration/deceleration pattern"

Set the acceleration/deceleration pattern.

Parameter Number	Factory Setting	Setting Range
29	0	0, 1, 2

Related parameters

Pr. 3 "base frequency"
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 20 "acceleration/deceleration reference frequency"
Pr. 44 "second acceleration/deceleration time"
Pr. 45 "second deceleration time"



<Setting>

Pr. 29 Setting	Function	Description
0	Linear acceleration/ deceleration	Linear acceleration/deceleration is made up/down to the preset frequency (factory setting).
1	S-shaped acceleration/ deceleration A (Note)	For machine tool spindles This setting is used when it is necessary to make acceleration/deceleration in a short time up to the base frequency or higher speed range. In this acceleration/deceleration pattern, fb (base frequency) is always the inflection point of an S shape, and you can set the acceleration/deceleration time according to the reduction in motor torque in the base frequency or higher constant-output operation range.
2	S-shaped acceleration/ deceleration B	For prevention of cargo collapse on conveyor, etc. This setting provides S-shaped acceleration/deceleration from f2 (current frequency) to f1 (target frequency), easing an acceleration/deceleration shock. This pattern has an effect on the prevention of cargo collapse, etc.

Note: For the acceleration/deceleration time, set the time required to reach the "base frequency" in Pr. 3, not the "acceleration/deceleration reference frequency" in Pr. 20.

4.2.13 Regenerative brake duty (Pr. 30, Pr. 70)

Pr. 30 "regenerative function selection"

Pr. 70 "special regenerative brake duty"

- When making frequent starts/stops, use the optional "brake resistor" to increase the regenerative brake duty.

Parameter Number	Factory Setting	Setting Range
30	0	0,1
70	0%	0 to 30%

<Setting>

(1) When using the built-in brake resistor, brake unit

- Set "0" in Pr. 30.
  The Pr. 70 setting is made invalid.

(2) When using the external high-duty brake resistor

- Set "1" in Pr. 30.
- Set "10%" in Pr. 70.

Note: 1. Pr. 70 "special regenerative brake duty" indicates the %ED of the built-in brake transistor operation. The setting should not be higher than the permissible value of the brake resistor used. Otherwise, the resistor can overheat.
2. When Pr. 30 = "0", Pr. 70 is not displayed but the brake duty is fixed at 2%.

⚠WARNING

⚠The value set in Pr. 70 should not exceed the value set to the brake resistor used.
Otherwise, the resistor can overheat.

4.2.14 Frequency jump (Pr. 31 to Pr. 36)

Pr. 31 "frequency jump 1A"

Pr. 32 "frequency jump 1B"

Pr. 33 "frequency jump 2A"

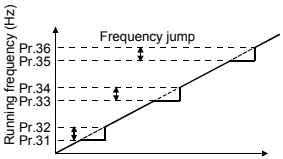
Pr. 34 "frequency jump 2B"

Pr. 35 "frequency jump 3A"

Pr. 36 "frequency jump 3B"

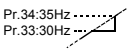
- When it is desired to avoid resonance attributable to the natural frequency of a mechanical system, these parameters allow resonant frequencies to be jumped. Up to three areas may be set, with the jump frequencies set to either the top or bottom point of each area.
- The value set to 1A, 2A or 3A is a jump point and operation is performed at this frequency.

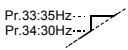
Parameter Number	Factory Setting	Setting Range	Remarks
31	9999	0 to 400Hz, 9999	9999: Function invalid
32	9999	0 to 400Hz, 9999	9999: Function invalid
33	9999	0 to 400Hz, 9999	9999: Function invalid
34	9999	0 to 400Hz, 9999	9999: Function invalid
35	9999	0 to 400Hz, 9999	9999: Function invalid
36	9999	0 to 400Hz, 9999	9999: Function invalid



<Setting>

- To fix the frequency at 30Hz between Pr. 33 and Pr. 34 (30Hz and 35Hz), set 35Hz in Pr. 34 and 30Hz in Pr. 33.
- To jump to 35Hz between 30 and 35Hz, set 35Hz in Pr. 33 and 30Hz in Pr. 34.





Note: During acceleration/deceleration, the running frequency within the set area is valid.

4.2.15 Speed display (Pr. 37)

Pr. 37 "speed display"

Related parameter
Pr. 52 "operation panel/PU main display data selection"

The unit of the output frequency display of the operation panel (FR-PA02-02) and PU (FR-PU04-MGI) can be changed from the frequency to the motor speed or machine speed.

Parameter Number	Factory Setting	Setting Range	Remarks
37	0	0, 0.01 to 9998	0: Output frequency

<Setting>

- To display the machine speed, set in Pr. 37 the machine speed for 60Hz operation.

Note: 1. The motor speed is converted into the output frequency and does not match the actual speed.
2. To change the operation panel monitor (PU main display), refer to Pr. 52.
3. As the operation panel display is 4 digits, "----" is displayed when the monitored value exceeds "9999".
4. Only the PU monitor display uses the unit set in this parameter. Set the other speed-related parameters (e.g. Pr. 1) in the frequency unit.
5. Due to the restrictions of the resolution of the set frequency, the displayed value may be different from the setting for the second decimal place.

⚠ CAUTION

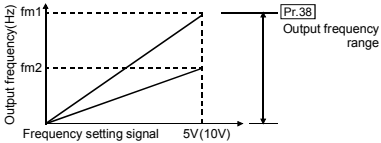
⚠ **Make sure that the running speed setting is correct.**
Otherwise, the motor might run at extremely high speed, damaging the machine.

4.2.16 Frequency at 5V (10V) input (Pr. 38)

Pr. 38 "frequency at 5V (10V) input"

Related parameters
Pr. 73 "0-5V/0-10V selection"
Pr. 79 "operation mode selection"
Pr. 254 "analog polarity reversible lower limit"
Pr. 902 "frequency setting voltage bias"
Pr. 903 "frequency setting voltage gain"

- You can set the frequency provided when the frequency setting signal from the potentiometer connected across terminals 2-5 (frequency setting potentiometer) is 5VDC (or 10VDC).



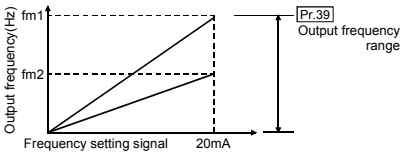
Parameter Number	Factory Setting	Setting Range
38	60Hz	1 to 400Hz

4.2.17 Frequency at 20mA input (Pr. 39)

Pr. 39 "frequency at 20mA input"

Related parameters
Pr. 79 "operation mode selection"
Pr. 904 "frequency setting current bias"
Pr. 905 "frequency setting current gain"

- You can set the frequency provided when the frequency setting signal input across terminals 4-5 is 20mA.



Parameter Number	Factory Setting	Setting Range
39	60Hz	1 to 400Hz

4.2.18 Up-to-frequency sensitivity (Pr. 41)

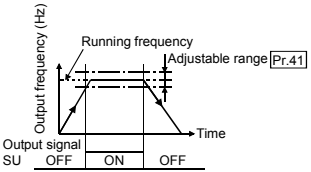
Pr. 41 "up-to-frequency sensitivity"

Related parameters

Pr. 190 to Pr. 192 (output terminal function selection)

The ON range of the up-to-frequency signal (SU) output when the output frequency reaches the running frequency can be adjusted between 0 and ±100% of the running frequency.
This parameter can be used to ensure that the running frequency has been reached or used as the operation start signal etc. for related equipment.

Parameter Number	Factory Setting	Setting Range
41	10%	0 to 100%



- Use any of Pr. 190 to Pr. 192 to allocate the terminal used for SU signal output. Refer to page 149 for Pr. 190 to Pr. 192 (output terminal function selection).

Note: When terminal assignment is changed using Pr. 190 to Pr. 192, the other functions may be affected. Check the functions of the corresponding terminals before making settings.

4.2.19 Output frequency detection (Pr. 42, Pr. 43)

Pr. 42 "output frequency detection"

Pr. 43 "output frequency detection for reverse rotation"

Related parameters

Pr. 190 to Pr. 192 (output terminal function selection)

The output frequency detection signal (FU) is output when the output frequency reaches or exceeds the setting. This function can be used for electromagnetic brake operation, open signal etc.

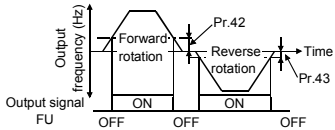
- You can also set the detection of the frequency used exclusively for reverse rotation. This function is effective for switching the timing of electromagnetic brake operation between forward rotation (rise) and reverse rotation (fall) during vertical lift operation etc.

Parameter Number	Factory Setting	Setting Range	Remarks
42	6Hz	0 to 400Hz	
43	9999	0 to 400Hz, 9999	9999: Same as Pr. 42 setting

<Setting>

Refer to the figure below and set the corresponding parameters:

- When Pr. 43 ≠ 9999, the Pr. 42 setting applies to forward rotation and the Pr. 43 setting applies to reverse rotation.
- Assign the terminal used for FU signal output with any of Pr. 190 to Pr. 192 (output terminal function selection).
  Refer to page 149 for Pr. 190 to Pr. 192 (output terminal function selection).



Note: Changing the terminal assignment using Pr. 190 to Pr. 192 may affect the other functions. Make setting after confirming the function of each terminal.

Pr. 44, Pr. 45 ➔Refer to Pr. 7.

Pr. 46 ➔Refer to Pr. 0.

Pr. 47 ➔Refer to Pr. 3.

Pr. 48 ➔Refer to Pr. 9.

4.2.20 Monitor display (Pr. 52, Pr. 158)

Pr. 52 "operation panel/PU main display data selection"

Pr. 158 "AM terminal function selection"

Related parameters
Pr. 37 "speed display"
Pr. 55 "frequency monitoring reference"
Pr. 56 "current monitoring reference"
Pr. 171 "actual operation hour meter clear"
Pr. 901 "AM terminal calibration"

You can select the signals shown on the operation panel (FR-PA02-02)/parameter unit (FR-PU04-MGI) main display screen and the signal output to the AM terminal .
- Output terminal: Terminal AM (analog output)
- Output signal selection: Pr. 158 "AM terminal function selection"

Parameter Number	Factory Setting	Setting Range
52	0	0, 23, 100
158	0	0, 1, 2

<Setting>
Set Pr. 52 and Pr. 158 in accordance with the following table:

Signal Type	Unit	Parameter Setting			Full-Scale Value of AM Level Meter
		Pr. 52		Pr. 158	
		Operation panel LED	PU main monitor	AM terminal	
Output frequency	Hz	0/100	0/100	0	Pr. 55
Output current	A	0/100	0/100	1	Pr. 56
Output voltage	——	0/100	0/100	2	1000V
Alarm display	——	0/100	0/100	×	——
Actual operation time	10h	23	23	×	——

When 100 is set in Pr. 52, the monitored values during stop and during operation differ as indicated below: (When using the operation panel (FR-PA02-02), LED of Hz flickers during stop and is lit during operation.)

	Pr. 52		
	0	100	
	During operation/ during stop	During stop	During operation
Output frequency	Output frequency	Set frequency	Output frequency
Output current	Output current		
Output voltage	Output voltage		
Alarm display	Alarm display		

Note: 1. During an error, the output frequency at error occurrence is displayed.
2. During MRS, the values are the same as during a stop.
During offline auto tuning, the tuning status monitor has priority.

Note: 1. The monitoring of items marked × cannot be selected.
2. By setting "0" in Pr. 52, the monitoring of "output frequency to alarm display" can be selected in sequence by the SET key.
3. Running speed on the PU main monitor is selected by "other monitor selection" of the parameter unit (FR-PU04-MGI).
4. The actual operation time displayed by setting "23" in Pr. 52 is calculated using the inverter operation time. (Inverter stop time is not included.) Set "0" in Pr. 171 to clear it.
5. The actual operation time is calculated from 0 to 99990 hours, then cleared, and recalculated from 0. If the operation time is less than 10 hours there is no display.
6. The actual operation time is not calculated if the inverter has not operated for more than 1 hour continuously.
7. When the operation panel is used, the display unit is Hz or A only.

4.2.21 Monitoring reference (Pr. 55, Pr. 56)

Pr. 55 "frequency monitoring reference"

Pr. 56 "current monitoring reference"

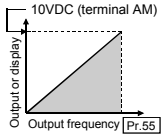
Related parameters

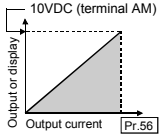
Pr. 158 "AM terminal function selection"

Pr. 901 "AM terminal calibration"

Set the frequency or current which is referenced when the output frequency or output current is selected for terminal AM.

Parameter Number	Factory Setting	Setting Range
55	60Hz	0 to 400Hz
56	Rated output current	0 to 500A





<Setting>

Refer to the above diagrams and set the frequency monitoring reference value in Pr. 55 and the current monitoring reference value in Pr. 56.

Refer to the above diagrams and set the frequency monitoring reference value in Pr. 55 and the current monitoring reference value in Pr. 56.
Pr. 55 is set when Pr. 158 = 0 and Pr. 56 is set when Pr. 158 = 1.
In Pr. 55 and Pr. 56, set the frequency and current at which the output voltage of terminal AM will be 10V.

Note: The maximum output voltage of terminal AM is 10VDC.

4.2.22 Automatic restart after instantaneous power failure (Pr. 57, Pr. 58)

Pr. 57 "restart coasting time"

Pr. 58 "restart cushion time"

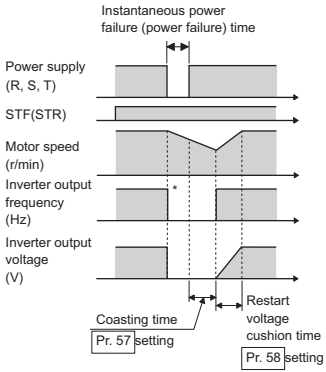
- You can restart the inverter without stopping the motor (with the motor coasting) when power is restored after an instantaneous power failure.

Parameter Number	Factory Setting	Setting Range	Remarks
57	9999	0 to 5 s, 9999	9999: No restart
58	1.0 s	0 to 60 s	

<Setting>

Refer to the following table and set the parameters:

Parameter Number	Setting	Description		
57	0	001 to 002	0.5 s coasting time	Generally use this setting.
		003 to 010	3.0 s coasting time	
	0.1 to 5 s	Waiting time for inverter-triggered restart after power is restored from an instantaneous power failure. (Set this time between 0.1s and 5s according to the inertia moment (J) and torque of the load.)		
	9999	No restart		
58	0 to 60 s	Normally the inverter may be run with the factory settings. These values are adjustable to the load (inertia moment, torque).		



*The output shut off timing differs according to the load condition.

Note: 1. Automatic restart after instantaneous power failure uses a reduced-voltage starting system in which the output voltage is raised gradually with the preset frequency unchanged, independently of the coasting speed of the motor.
2. The SU and FU signals are not output during restart but are output after the restart cushion time has elapsed.

⚠ CAUTION

⚠ **When automatic restart after instantaneous power failure has been selected, the motor and machine will start suddenly (after the reset time has elapsed) after occurrence of an instantaneous power failure.**
Stay away from the motor and machine.
When you have selected automatic restart after instantaneous power failure, apply the supplied CAUTION seals in easily visible places.

⚠ **When the start signal is turned off or the STOP RESET key is pressed during the cushion time for automatic restart after instantaneous power failure, deceleration starts after the automatic restart cushion time set in Pr. 58 "cushion time for automatic restart after instantaneous power failure" has elapsed.**

4.2.23 Remote setting function selection (Pr. 59)

Pr. 59 "remote setting function selection"

If the operator panel is located away from the control box, you can use contact signals to perform continuous variable-speed operation, without using analog signals.

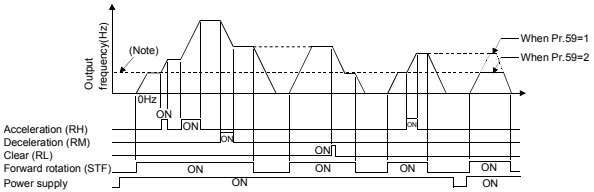
Related parameters

Pr. 1 "maximum frequency"
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 18 "high-speed maximum frequency"
Pr. 44 "second acceleration/deceleration time"
Pr. 45 "second deceleration time"

- When the remote function is used, the output frequency of the inverter can be compensated for as follows:

  External operation mode: Frequency set by RH/RM operation plus external analog frequency command
  PU operation mode: Frequency set by RH/RM operation plus PU's digitally-set frequency

Parameter Number	Factory Setting	Setting Range
59	0	0, 1, 2



Note: External operation frequency or PU operation frequency other than multi-speed

Pr. 59 Setting	Operation	
	Remote setting function	Frequency setting storage function (E^2PROM)
0	No	—
1	Yes	Yes
2	Yes	No

- Use Pr. 59 to select whether the remote setting function is used or not and whether the frequency setting storage function* in the remote setting mode is used or not. When "remote setting function - yes" is selected, the functions of signals RH, RM and RL are changed to acceleration (RH), deceleration (RM) and clear (RL). Use Pr. 180 to Pr. 183 (input terminal function selection) to set signals RH, RM and RL.

* Frequency setting storage function
The remote setting frequency (frequency set by RH, RM operation) is stored into memory. When power is switched off once, then on again, operation is resumed at this setting of the output frequency. (Pr. 59=1)

<Frequency setting storage condition>

- Frequency at the time when the start signal (STF or STR) has switched off
- The remotely-set frequency is stored every one minute after one minute has elapsed since turn off (on) of both the RH (acceleration) and RM (deceleration) signals. (The frequency is written if the present frequency setting compared with the past frequency setting every one minute is different.) (The state of the RL signal dose not affect writing.)

Note: 1. The frequency can be varied by RH (acceleration) and RM (deceleration) between 0 and the maximum frequency (Pr. 1 or Pr. 18 setting).

2. When the acceleration or deceleration signal switches on, the set frequency varies according to the slope set in Pr. 44 or Pr. 45. The output frequency acceleration/deceleration times are as set in Pr. 7 and Pr. 8, respectively. Therefore, the longer preset times are used to vary the actual output frequency.
3. If the start signal (STF or STR) is off, turning on the acceleration (RH) or deceleration (RM) signal varies the set frequency.
4. When switching the start signal from ON to OFF, or changing frequency by the RH or RM signal frequently, set the frequency setting value storage function (E^2PROM) invalid (Pr.59="2").

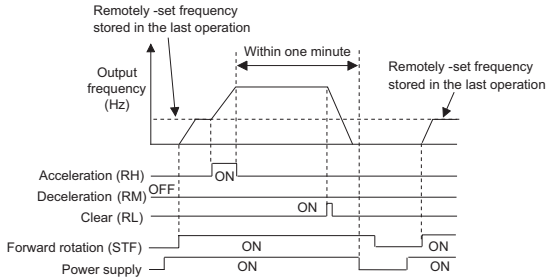
   If set invalid (Pr.59="1"), frequency is written to E^2PROM frequently, this will shorten the life of the E^2PROM.

REMARKS

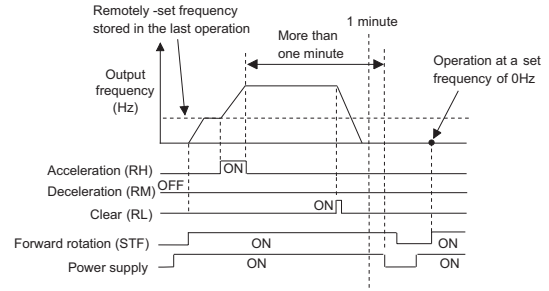
This function is invalid during jog operation and PID control operation.

Setting frequency is "0"

- Even when the remotely-set frequency is cleared by turning on the RL (clear) signal after turn off (on) of both the RH and RM signals, the inverter operates at the remotely-set frequency stored in the last operation if power is reapplied before one minute has elapsed since turn off (on) of both the RH and RM signals



- When the remotely-set frequency is cleared by turning on the RL (clear) signal after turn off (on) of both the RH and RM signals, the inverter operates at the frequency in the remotely-set frequency cleared state if power is reapplied after one minute has elapsed since turn off (on) of both the RH and RM signals.



⚠ CAUTION

⚠ **When selecting this function, re-set the maximum frequency according to the machine.**

4.2.24 Shortest acceleration/deceleration mode (Pr. 60 to Pr. 63)

Pr. 60 "shortest acceleration/deceleration mode"

Pr. 61 "reference current"

Pr. 62 "reference current for acceleration"

Pr. 63 "reference current for deceleration"

Related parameters
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"

The inverter automatically sets the shortest time for acceleration/deceleration for operation.

- If you do not set the acceleration and deceleration times and V/F pattern, you can run the inverter as if appropriate values had been set in the corresponding parameters. This operation mode is useful when you want to operate without fine parameter setting.
  Pr. 61 to Pr. 63 are valid only when Pr. 60 = "1, 2, 11,12".
  When the shortest acceleration/deceleration mode is selected, the setting values of Pr. 7 "acceleration time", Pr. 8 "deceleration time", Pr. 22 "stall prevention operation level" are made invalid.

Parameter Number	Factory Setting	Setting Range	Remarks
60	0	0, 1, 2, 11, 12	
61	9999	0 to 500A, 9999	9999: Referenced from rated inverter current.
62	9999	0 to 200%, 9999	
63	9999	0 to 200%, 9999	

<Setting>

Pr. 60 Setting	Operation Mode	Description		Invalid parameter
0	Ordinary operation mode	————		————
1	Shortest acceleration/ deceleration mode I	Set to accelerate/decelerate the motor in the shortest time. The inverter makes acceleration/ deceleration in the shortest time using its full capabilities. Set "11" or "12" when using brake resistance and the brake unit.	Stall prevention operation level 150%	Pr. 7, Pr. 8, Pr. 22
11				
2	Shortest acceleration/ deceleration mode II		Stall prevention operation level 180%	
12				

Note: When the shortest acceleration/deceleration mode is selected, regenerative over voltage (E.OV3) may occur if the regenerative brake does not have enough capability at deceleration.

- Set the parameters when it is desired to improve the performance in the shortest acceleration/deceleration mode.

(1) Pr. 61 "reference current"

Set the current value (A) that is referenced for stall prevention operation level.
Set this value when you want to use the motor rated current as reference such as when capacities of the motor and inverter differ.

Setting	Reference Current
9999 (factory setting)	Referenced from rated inverter current
0 to 500A	Referenced from setting (rated motor current)

(2) Pr. 62 "reference current for acceleration"

Set the stall prevention operation level (%) at acceleration.
Set when you want to restrict torque at acceleration, etc.
The value set in Pr.61 "reference current" becomes the reference value (100%).

Setting	Reference Current
9999 (factory setting)	150% (180%) is the limit value.
0 to 200%	The setting of 0 to 200% is the limit value.

(3) Pr. 63 "reference current for deceleration"

Set the stall prevention operation level (%) at deceleration.
Set when you want to restrict torque at deceleration, etc.
The value set in Pr.61 "reference current" becomes the reference value (100%).

Setting	Reference Current
9999 (factory setting)	150% (180%) is the limit value.
0 to 200%	The setting of 0 to 200% is the limit value.

4.2.25 Retry function (Pr. 65, Pr. 67 to Pr. 69)

Pr. 65 "retry selection"

Pr. 67 "number of retries at alarm occurrence"

Pr. 68 "retry waiting time"

Pr. 69 "retry count display erasure"

When any protective function (major fault) is activated and the inverter stops its output, the inverter itself resets automatically and performs retries. You can select whether retry is made or not, alarms reset for retry, number of retries made, and waiting time.

Parameter Number	Factory Setting	Setting Range
65	0	0 to 3
67	0	0 to 10, 101 to 110
68	1 s	0.1 to 360 s
69	0	0

<Setting>

Use Pr. 65 to select the protective functions (major faults) which execute retry.

Errors Reset for Retry	Setting			
Display	0	1	2	3
E.OC1	●	●		●
E.OC2	●	●		●
E.OC3	●	●		●
E.OV1	●		●	●
E.OV2	●		●	●
E.OV3	●		●	●
E.THM	●			
E.THT	●			
E.FIN				
E. BE	●			
E. GF	●			
E. LF				
E.OHT	●			
E.OLT	●			
E.OPT	●			
E. PE	●			
E.PUE				
E.RET				
E.CPU				
E.P24				
E. 3				
E. 6				
E. 7				

Note: ● indicates the retry items selected.

Use Pr. 67 to set the number of retries at alarm occurrence.

Pr. 67 Setting	Number of Retries	Alarm Signal Output
0	Retry is not made.	————
1 to 10	1 to 10 times	Not output.
101 to 110	1 to 10 times	Output.

- Use Pr. 68 to set the waiting time from when an inverter alarm occurs until a restart in the range 0.1 to 360s.
- Reading the Pr. 69 value provides the cumulative number of successful restart times made by retry. The setting of "0" erases the cumulative number of times.

Note: 1. The cumulative number in Pr. 69 is incremented by "1" when retry operation is regarded as successful, i.e. when normal operation is continued without the protective function (major fault) activated during a period five times longer than the time set in Pr. 68.
2. If the protective function (major fault) is activated consecutively within a period five times longer than the above waiting time, the operation panel may show data different from the most recent data or the parameter unit (FR-PU04-MGI) may show data different from the first retry data. The data stored as the error reset for retry is only that of the protective function (major fault) which was activated the first time.
3. When an inverter alarm is reset by the retry function at the retry time, the stored data of the electronic thermal relay function, etc. are not cleared. (Different from the power-on reset.)

⚠ CAUTION

⚠ **When you have selected the retry function, stay away from the motor and machine unless required. They will start suddenly (after the reset time has elapsed) after occurrence of an alarm.**
When you have selected the retry function, apply the supplied CAUTION stickers easily visible places.

Pr. 66 ➔Refer to Pr. 22.

Pr. 70 ➔Refer to Pr. 30.

4.2.26 Applied motor (Pr. 71)

Pr. 71 "applied motor"

Related parameters
Pr. 0 "torque boost"
Pr. 12 "DC injection brake voltage"
Pr. 19 "base frequency voltage"
Pr. 80 "motor capacity"
Pr. 96 "auto-tuning setting/status"

Set the motor used.

- When using the constant-torque motor, set "1" in Pr. 71 for either V/F control or general-purpose magnetic flux vector control.
  The electronic thermal relay function is set to the thermal characteristic of the constant-torque motor.
- When you selected the constant-torque motor, the values of the following parameters are automatically changed. (only for the factory setting value)
  Pr. 0 "torque boost", Pr. 12 "DC injection brake voltage"

Parameter Number	Factory Setting	Setting Range
71	0	0, 1, 3, 5, 6, 13, 15, 16, 23, 100, 101, 103, 105, 106, 113, 115, 116, 123

<Setting>

- Refer to the following list and set this parameter according to the motor used.

Pr. 71 Setting	Thermal Characteristics of Electronic Thermal Relay Function			Applied motor	
				Standard	Constant-Torque
0, 100	Thermal characteristics of a standard motor			○	
1, 101	Thermal characteristics of a constant-torque motor				○
3, 103	Standard motor	Select "offline auto tuning setting".		○	
13, 113	Constant-torque motor				○
23, 123	Do not set.			—	—
5, 105	Standard motor	Star connection	Motor constants can be entered directly.	○	
15, 115	Constant-torque motor				○
6, 106	Standard motor	Delta connection		○	
16, 116	Constant-torque motor				○

By setting any of "100 to 123", thermal characteristic of electronic thermal relay function (applied motor) can be changed as indicated below according to the ON/OFF status of the RT signal:

RT Signal	Thermal Characteristic of Electronic Thermal Relay Function (Applied Motor)
OFF	As indicated in the above table
ON	Constant-torque motor

⚠ CAUTION

⚠ **Set this parameter correctly according to the motor used.**
Incorrect setting may cause the motor to overheat and burn.
Set the electronic thermal relay function to the thermal characteristic for the constant-torque motor when using a geared motor (GM-G, GM-D, GM-SY, GM-HY2 series) to perform general-purpose magnetic-flux vector control.

4.2.27 PWM carrier frequency (Pr. 72, Pr. 240)

Pr. 72 "PWM frequency selection"

Pr. 240 "Soft-PWM setting"

You can change the motor tone.

- By parameter setting, you can select Soft-PWM control which changes the motor tone.
- Soft-PWM control changes motor noise from a metallic tone into an unoffending complex tone.

Parameter Number	Factory Setting	Setting Range	Remarks
72	1	0 to 15	0: 0.7kHz, 15: 14.5kHz
240	1	0, 1	1: Soft-PWM valid

<Setting>

- Refer to the following list and set the parameters:

Parameter Number	Setting	Description
72	0 to 15	PWM carrier frequency can be changed. The setting displayed is in [kHz]. Note that 0 indicates 0.7kHz and 15 indicates 14.5kHz.
240	0	Soft-PWM invalid
	1	When any of "0 to 5" is set in Pr. 72, Soft-PWM is made valid.

Note: 1. Note that when the inverter is run at the ambient temperature above 40°C (104°F) with a 2kHz or higher value set in Pr. 72, the rated output current of the inverter must be reduced. (Refer to page 190 (depending upon the inverter).)

2. An increased PWM frequency will decrease the motor sound but increase noise and leakage currents. Therefore, perform the reduction techniques (Refer to pages 35 to 39).

4.2.28 Voltage input (Pr. 73, Pr. 254)

Pr. 73 "0-5V/0-10V selection"

Pr. 254 "analog polarity reversible lower limit"

Related parameters

Pr. 38 "frequency at 5V (10V) input"
Pr. 902 "frequency setting voltage bias"
Pr. 903 "frequency setting voltage gain"

• You can change the input (terminal 2) specifications in response to the frequency setting voltage signal. When entering 0 to 10VDC, always make this setting.

Parameter Number	Factory Setting	Setting Range	Remarks
73	0	0, 1, 10, 11 (Note)	
254	9999	0 to 100%, 9999 (Note)	9999: Function invalid

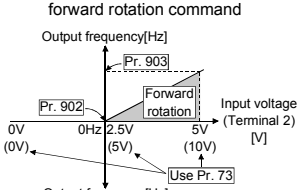
Note:When setting "10" or "11" in Pr. 73 and any value in Pr. 254, set "801" in Pr. 77

Parameter Number	Setting	Terminal 2 Input Voltage	Polarity Reversible
73	0	For 0 to 5VDC input (factory setting)	No
	1	For 0 to 10VDC input	
	10	For 0 to 5VDC input	Valid
	11	For 0 to 10VDC input	

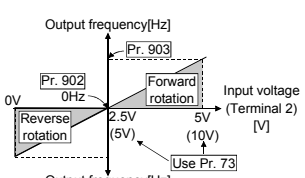
Note: 1. To change the maximum output frequency at the input of the maximum frequency command voltage, use Pr. 38. Also, the acceleration/deceleration time, which is a slope up/down to the acceleration/deceleration reference frequency, is not affected by the change in Pr. 73 setting.
2. When connecting a frequency setting potentiometer across terminals 10-2-5 for operation, always set "0" in this parameter.

● Polarity reversible operation
By changing the input voltage, you can switch between forward rotation and reverse rotation. Set "801" in Pr. 77 and "10" or "11" in Pr. 73 to make this function valid.

1) Set the output frequency using Pr. 902 "frequency setting voltage bias" and Pr. 903 "frequency setting voltage gain".
Ex.) When setting 0Hz and 2.5V in Pr.902 and 60Hz and 5V in Pr. 903 to give a forward rotation command



Pr. 73 = "0" or "1"



Pr. 73 = "10" or "11"

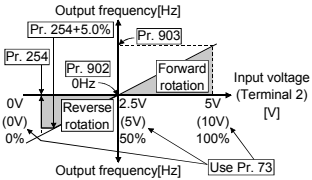
When Pr. 73 = "10" as factory-set, Pr. 902 = 2.5V. When Pr. 73 = "11", Pr. 902 = 5V.

2)Pr. 254 " analog polarity reversible lower limit "
The lower limit of the analog voltage value applied across terminals 2-5 can be set. (This setting will prevent a reversible operation (rotation) when the analog voltage applied across terminals 2-5 drops.)
Terminal 2 input voltage is 0V = 0% and 5V (10V) = 100%.

Note: Set "10" or "11" in Pr. 73 and any value in Pr. 254 to make this function valid.

<Output frequency under the following conditions>

- When analog voltage value < Pr. 254 setting (%), output frequency of inverter is 0Hz.
- When Pr. 254 setting (%) ≤ analog voltage value (%) ≤ Pr. 254 setting (%) + 5.0%, output frequency is same as when Pr. 254 setting (%) + 5.0%
  Ex.) When setting "10"or "11" in Pr. 73, 0Hz and 2.5V in Pr. 902, and 60Hz and 5V in Pr. 903 to give a forward rotation command



REMARKS

A reversible operation can not be performed during PID control.

Note: If "801" is set in Pr. 77, be sure to reset it to the original setting.

⚠ WARNING

⚠ Do not design the wiring and facility which will make the voltage lower than the Pr. 902 setting suddenly.
Doing so can cause the inverter to provide reverse rotation output if the analog signal wiring is disconnected or the speed command analog signal turns to 0V, resulting in hazardous conditions.

4

4.2.29 Input filter time constant (Pr. 74)

Pr. 74 "filter time constant"

You can set the input section's internal filter constant for an external voltage or current frequency setting signal.

- Effective for eliminating noise in the frequency setting circuit.
- Increase the filter time constant if steady operation cannot be performed due to noise. A larger setting results in slower response. (The time constant can be set between approximately 1ms to 1s with the setting of 0 to 8. A larger setting results in a larger filter time constant.)

Parameter Number	Factory Setting	Setting Range
74	1	0 to 8

4.2.30 Reset selection/disconnected PU detection/PU stop selection (Pr. 75)

Pr. 75 "reset selection/disconnected PU detection/PU stop selection"

You can select the reset input acceptance, PU(FR-PA02-02/FR-PU04-MGI) connector disconnection detection function and PU stop function.

- Reset selection : You can select the reset function input timing.
- PU disconnection detection: When it is detected that the PU(FR-PA02-02/FR-PU04-MGI) is disconnected from the inverter for more than 1s, the inverter outputs an alarm code (E.PUE) and comes to an alarm stop.
- PU stop selection : When an alarm occurs in any operation mode, you can stop the inverter from the PU by pressing the STOP RESET key.

Parameter Number	Factory Setting	Setting Range
75	14	0 to 3, 14 to 17

<Setting>

Pr. 75 Setting	Reset Selection	PU Disconnection Detection	PU Stop Selection
0	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing the STOP RESET key decelerates the inverter to a stop only in the PU operation mode.
1	Reset input enabled only when the protective function is activated.		
2	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	
3	Reset input enabled only when the protective function is activated.		
14	Reset input normally enabled.	If the PU is disconnected, operation will be continued.	Pressing the STOP RESET key decelerates the inverter to a stop in any of the PU, external and communication operation modes.
15	Reset input enabled only when the protective function is activated.		
16	Reset input normally enabled.	When the PU is disconnected, an error is displayed on the PU and the inverter output is shut off.	
17	Reset input enabled only when the protective function is activated.		

How to make a restart after a stop by the STOP/RESET key on the PU

(1) Operation panel (FR-PA02-02)

1) After completion of deceleration to a stop, switch off the STF or STR signal.
2) Press the MODE key two times* to display "OPRd".

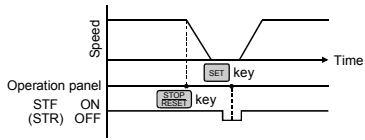
> Note: When Pr. 79 = 3, press the MODE key three times, to display "PU". Then, press the ▼ key and proceed to step 3).

(For the monitor screen) .....Refer to page 50 for the monitor display provided by pressing the MODE key.

3) Press the SET key.
4) Switch on the STF or STR signal.

(2) Parameter unit (FR-PU04-MGI)

1) After completion of deceleration to a stop, switch off the STF or STR signal.
2) Press the SET key.
3) Switch on the STF or STR signal.



Stop and restart example for external operation

The other way of making a restart other than the above method is to perform a power-reset or to make a reset with the inverter reset terminal.

Note: 1. By entering the reset signal (RES) during operation, the inverter shuts off output while it is reset, the data of the electronic thermal relay function and regenerative brake duty are reset, and the motor coasts.
2. The PU disconnection detection function judges that the PU is disconnected when it is removed from the inverter for more than 1s. If the PU had been disconnected before power-on, it is not judged as an alarm.
3. To resume operation, reset the inverter after confirming that the PU is connected securely.
4. The Pr. 75 value can be set any time. Also, if parameter (all) clear is executed, this setting will not return to the initial value.
5. When the inverter is stopped by the PU stop function, PS is displayed but an alarm is not output.
When the PU connector is used for RS-485 communication operation, the reset selection and PU stop selection functions are valid but the PU disconnection detection function is invalid.

⚠ CAUTION

⚠ **Do not reset the inverter with the start signal on.**
Otherwise, the motor will start instantly after resetting, leading to potentially hazardous conditions.

4.2.31 Parameter write disable selection (Pr. 77)

Pr. 77 "parameter write disable selection"

Related parameters
Pr. 79 "operation mode selection"

You can select between write-enable and disable for parameters. This function is used to prevent parameter values from being rewritten by incorrect operation.

Parameter Number	Factory Setting	Setting Range
77	0	0, 1, 2

<Setting>

Pr. 77 Setting	Function
0	Parameter values may only be written during a stop in the PU operation mode. (Note 1)
1	Write disabled. (Note 2) Values of Pr. 22, Pr. 75, Pr. 77 and Pr. 79 "operation mode selection" can be written.
2	Write enabled even during operation. (Note 3) Setting is enabled independently of the operation mode.

Note: 1. The shaded parameters in the parameter list (page 62) can be set at any time.
2. By setting "1" in Pr. 77, the following clear operations can be inhibited:
   - Parameter clear
   - Parameter all clear
3. If Pr. 77 = 2, the values of Pr. 23, Pr. 66, Pr. 71, Pr. 79, Pr. 80, Pr. 83, Pr. 84, Pr. 96, Pr. 180 to Pr.183 and Pr. 190 to Pr. 192 cannot be written during operation. Stop operation when changing their parameter settings.

4.2.32 Reverse rotation prevention selection (Pr. 78)

Pr. 78 "reverse rotation prevention selection"

Related parameters
Pr. 79 "operation mode selection"

This function can prevent any reverse rotation fault resulting from the incorrect input of the start signal.

- Used for a machine which runs only in one direction, e.g. fan, pump.
  (The setting of this function is valid for the combined, PU, external and communication operations.)

Parameter Number	Factory Setting	Setting Range
78	0	0, 1, 2

<Setting>

Pr. 78 Setting	Function
0	Both forward and reverse rotations allowed
1	Reverse rotation disallowed
2	Forward rotation disallowed

4.2.33 Operation mode selection (Pr. 79)

Pr. 79 "operation mode selection"

Related parameters
Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239 (multi-speed operation)
Pr. 75 "reset selection/disconnected PU detection/PU stop selection"
Pr. 180 to Pr. 183 (input terminal function selection)

Used to select the operation mode of the inverter. The inverter can be run from the operation panel or parameter unit (PU operation), with external signals (external operation), or by combination of PU operation and external operation (external/PU combined operation).
When power is switched on (factory setting), the external operation mode is selected.

Parameter Number	Factory Setting	Setting Range
79	0	0 to 4, 6 to 8

<Setting>

In the following table, operation using the operation panel or parameter unit is abbreviated to PU operation.

Pr. 79 Setting	Function		
0	When power is switched on, the external operation mode is selected. PU or external operation can be selected by pressing the keys of the operation panel or parameter unit. (Refer to page 60) For these modes, refer to the setting 1 and 2 below.		
	Operation mode	**Running frequency**	**Start signal**
1	PU operation mode	Digital setting by the key operation of the operation panel or parameter unit	RUN (FWD , REV) key of operation panel or FWD or REV key of parameter unit
2	External operation mode	External signal input (across terminals 2 (4)-5, multi-speed selection)	External signal input (terminal STF, STR)
3	External/PU combined operation mode 1	Digital setting by the key operation of the operation panel or parameter unit, or external signal input (multi-speed setting only)	External signal input (terminal STF, STR)
4	External/PU combined operation mode 2	External signal input (across terminals 2 (4)-5, multi-speed selection)	RUN (FWD , REV) key of operation panel or FWD or REV key of parameter unit
6	Switch-over mode Switch-over between PU and external operation modes can be done while running.		
7	External operation mode (PU operation interlock) MRS signal ON ..... Able to be switched to PU operation mode (output stop during external operation) MRS signal OFF ..... Switching to PU operation mode inhibited		
8	Switching to other than external operation mode (disallowed during operation) X16 signal ON ..... Switched to external operation mode X16 signal OFF..... Switched to PU operation mode		

Note: 1. Either "3" or "4" may be set to select the PU/external combined operation. These settings differ in starting method.

2. The stop function (PU stop selection) activated by pressing STOP RESET of the PU (FR-PA02-02/FR-PU04-MGI) is valid even in other than the PU operation mode when shipped from the factory. (Refer to page 108.)

(1) Switch-over mode

During operation, you can change the current operation mode to another operation mode.

Operation Mode Switching	Switching Control/Operating Status
External operation to PU operation	1) Operate the operation panel keys to select the PU operation mode. • Rotation direction is the same as that of external operation. • Set frequency is the same as the external frequency setting signal value. (Note that the setting will disappear when power is switched off or the inverter is reset.)
PU operation to external operation	1) Operate the operation panel keys to select the external operation mode. • Rotation direction is determined by the external operation input signal. • Set frequency is determined by the external frequency setting signal.

(2) PU operation interlock

PU operation interlock forces the operation mode to be changed to the external operation mode when the MRS signal switches off. This function prevents the inverter from being inoperative by the external command if the mode is accidentally left unswitched from the PU operation mode.

1)Preparation

- Set "7" in Pr. 79 (PU operation interlock).
- Set the terminal used for MRS signal input with any of Pr. 180 to Pr. 183 (input terminal function selection).
  Refer to page 147 for Pr. 180 to Pr. 183 (input terminal function selection).

Note: When terminal assignment is changed using Pr. 180 to Pr. 183, the other functions may be affected.
Check the functions of the corresponding terminals before making settings.

2)Function

MRS Signal	Function/Operation
ON	Output stopped during external operation. Operation mode can be switched to PU operation mode. Parameter values can be rewritten in PU operation mode. PU operation allowed.
OFF	Forcibly switched to external operation mode. External operation allowed. Switching to PU operation mode inhibited.

<Function/operation changed by switching on-off the MRS signal>

Operating Condition		MRS Signal	Operation Mode (Note 4)	Operating Status	Parameter Write	Switching to PU Operation Mode
Operation mode	Status					
PU	During stop	ON → OFF (Note 3)	External	During stop	Enabled → disabled	Disabled
	During operation	ON → OFF (Note 3)		If external operation frequency setting and start signal are entered, operation is performed in that status.	Enabled → disabled	Disabled
External	During stop	OFF → ON	External	During stop	Disabled → disabled	Enabled
		ON → OFF			Disabled → disabled	Disabled
	During operation	OFF → ON		During operation → output stop	Disabled → disabled	Disabled
		ON → OFF		Output stop → operation	Disabled → disabled	Disabled

Note: 1. If the MRS signal is on, the operation mode cannot be switched to the PU operation mode when the start signal (STF, STR) is on.
2. The operation mode switches to the external operation mode independently of whether the start signal (STF, STR) is on or off.
Therefore, the motor is run in the external operation mode when the MRS signal is switched off with either of STF and STR on.
3. When the protective function (major fault) is activated, the inverter can be reset by pressing the STOP/RESET key of the operation panel.
4. Switching the MRS signal on and rewriting the Pr. 79 value to other than "7" in the PU operation mode causes the MRS signal to provide the ordinary MRS function (output stop). Also as soon as "7" is set in Pr. 79, the operation mode is switched to PU operation mode.

(3) Operation mode switching by external signal

1) Preparation
Set "8" (switching to other than external operation mode) in Pr. 79.
Use any of Pr. 180 to Pr. 183 (input terminal function selection) to set the terminal used for X16 signal input.
Refer to page 147 for Pr. 180 to Pr. 183 (input terminal function selection).

Note: When terminal assignment is changed using Pr. 180 to Pr. 183, the other functions may be affected.
Check the functions of the corresponding terminals before making settings.

2) Function
This switching is enabled during an inverter stop only and cannot be achieved during operation.

X16 Signal	Operation Mode
ON	External operation mode (cannot be changed to the PU operation mode)
OFF	PU operation mode (cannot be changed to the external operation mode)

4.2.34 General-purpose magnetic flux vector control selection (Pr. 80)

Pr. 80 "motor capacity"

Related parameters

Pr. 71 "applied motor"
Pr. 83 "rated motor voltage"
Pr. 84 "rated motor frequency"
Pr. 96 "auto-tuning setting/status"

You can set the general-purpose magnetic flux vector control.

- General-purpose magnetic flux vector control
  Provides large starting torque and sufficient low-speed torque.
  If the motor constants vary slightly, stable, large low-speed torque is provided without specific motor constant setting or tuning.

Parameter Number	Factory Setting	Setting Range	Remarks
80	9999	0.4kW to 7.5kW, 9999	9999: V/F control

If any of the following conditions are not satisfied, faults such as torque shortage and speed fluctuation may occur. In this case, select V/F control.

<Operating conditions>

- The motor capacity is equal to or one rank lower than the inverter capacity.
- The number of motor poles is any of 2, 4, and 6. (4 poles only for the constant-torque motor)
- Single-motor operation (one motor for one inverter) is performed.
- The wiring length between the inverter and motor is within 30m (98.42 feet). (If the length is over 30m (98.42 feet), perform offline auto tuning with the cables wired.)

<Setting>

(1) General-purpose magnetic flux vector control

- The general-purpose magnetic flux vector control can be selected by setting the capacity of the motor used in Pr. 80.

Parameter Number	Setting	Description	
80	9999	V/F control	
	0.4 to 7.5	Set the motor capacity applied.	General-purpose magnetic flux vector control

- When using constant-torque motor, set "1" in Pr. 71.

4.2.35 Offline auto tuning function (Pr. 82 to Pr. 84, Pr. 90, Pr. 96)

Pr. 82 "motor excitation current"

Pr. 83 "rated motor voltage"

Pr. 84 "rated motor frequency"

Pr. 90 "motor constant (R1)"

Pr. 96 "auto-tuning setting/status"

Related parameters

Pr. 7 "acceleration time"
Pr. 9 "electronic thermal O/L relay "
Pr. 71 "applied motor"
Pr. 79 "operation mode selection"
Pr. 80 "motor capacity"

What is auto tuning?

(1) The general-purpose magnetic flux vector control system gets the best performance from the motor for operation.

(2) Using the offline auto tuning function to improve the operational performance of the motor.

When you use the general-purpose magnetic flux vector control, you can perform the offline auto tuning operation to calculate the motor constants automatically.

- Offline auto tuning is made valid only when Pr. 80 is set to other than "9999" to select the general-purpose magnetic flux vector control.
- Offline auto tuning

  Automatically measures the motor constants used for general-purpose magnetic flux vector control.
  - Offline auto tuning can be performed with the load connected.
  - The offline auto tuning status can be monitored with the operation panel (FR-PA02-02) or parameter unit (FR-PU04-MGI).
  - Only a static auto tune can be performed.
  - Offline auto tuning is available only when the motor is at a stop.
- Tuning data (motor constants) can be copied to another inverter with the PU (FR-PU04-MGI).
  - You can read, write and copy the motor constants tuned by the offline auto tuning.

Parameter Number	Factory Setting	Setting Range	Remarks
82	9999	0 to 500A, 9999	9999:Standard motor
83	575V	0 to 1000V	Rated inverter voltage
84	60Hz	50 to 120Hz	
90	9999	0 to 50Ω, 9999	9999:Standard motor
96	0	0, 1	0: No tuning

<Operating conditions>

- The motor is connected.
- The motor capacity is equal to or one rank lower than the inverter capacity.
- Special motors such as high-slip motors and high-speed motors cannot be tuned.
- The motor may move slightly. Therefore, fix the motor securely with a mechanical brake, or before tuning, make sure that there will be no problem in safety if the motor runs.
  *This instruction must be followed especially for vertical lift applications.
  If the motor runs slightly, tuning performance is unaffected.
- Offline auto tuning will not be performed properly if it is started when a reactor or surge voltage suppression filter is connected between the inverter and motor. Remove it before starting tuning.

<Setting>

(1) Parameter setting

- Set the motor capacity (kW) in Pr. 80 and select the general-purpose magnetic flux vector control.
- Refer to the parameter details list and set the following parameters:
  1) Set "1" in Pr. 96.
  2) Set the rated motor current (A) in Pr. 9.
  3) Set the rated motor voltage (V) in Pr. 83.
  4) Set the rated motor frequency (Hz) in Pr. 84.
  5) Select the motor using Pr. 71.
     - Standard motor ..... Pr. 71 = "3" or "103"
     - Constant-torque motor ..... Pr. 71 = "13" or "113"

Note: Pr. 83 and Pr. 84 are only displayed when the general-purpose magnetic flux vector control is selected.
In these parameters, set the values given on the motor plate.
After tuning is over, set the Pr. 9 "electronic thermal O/L relay" value to the rated current at the operating voltage/frequency.

■ **Parameter details**

Parameter Number	Setting	Description		
9	0 to 500A	Set the rated motor current (A).		
71 (Note)	0, 100	Thermal characteristics suitable for standard motor		
	1, 101	Thermal characteristics suitable for constant-torque motor		
	3, 103	Standard motor		Select "offline auto tuning setting"
	13, 113	Constant-torque motor		
	23, 123	Do not set.		
	5, 105	Standard motor	Star connection	Direct input of motor constants enabled
	15, 115	Constant-torque motor		
	6, 106	Standard motor	Delta connection	
	16, 116	Constant-torque motor		
83	0 to 1000V	Set the rated motor voltage (V).		
84	50 to 120Hz	Set the rated motor frequency (Hz).		
90	0 to 50Ω, 9999	Tuning data (Values measured by offline auto tuning are set automatically.)		
96	0	Offline auto tuning is not performed.		
	1	Offline auto tuning is performed.		

Note: The electronic thermal relay function characteristics are also selected simultaneously. By setting any of "100 to 123", the electronic thermal relay function changes to the thermal characteristic of the constant-torque motor when the RT signal switches on.

(2) Tuning execution

- For PU operation or combined operation 2, press the FWD or REV key.
- For external operation or combined operation 1, switch on the run command.

Note: 1. To force tuning to end
- Switch on the MRS or RES signal or press the STOP RESET key to end.
- Switch off the tuning start command to make a forced end.

2. During offline auto tuning, only the following I/O signals are valid:
- Input signals
  <Valid signals>
  MRS, RES, STF, STR
- Output signals
  RUN, AM, A, B, C

3. Special caution should be exercised when a sequence has been designed to open the mechanical brake with the RUN signal.

(3) Monitoring the offline tuning status

When the parameter unit (FR-PU04-MGI) is used, the Pr. 96 value is displayed during tuning on the main monitor as shown below. When the operation panel is used, the same value as on the FR-PU04-MGI is only displayed:

• Operation panel (FR-PA02-02) display

(For inverter trip)

	1. Setting	2. Tuning in progress	3. Completion	4. Error-activated end
Displayed value	1 →	2 →	3	9

• Parameter unit (FR-PU04-MGI) main monitor

(For inverter trip)

	1. Setting	2. Tuning in progress	3. Completion	4. Error-activated end
Display	1 ---STOP PU →	TUNE 2 STF FWD PU →	TUNE 3 COMPLETION STF STOP PU →	TUNE 9 ERROR STF STOP PU

• Reference: Offline auto tuning time (factory setting) is about 10s.

(4) Ending the offline auto tuning

1) Confirm the Pr. 96 value.
   - Normal end: "3" is displayed.
   - Abnormal end: "9", "91", "92" or "93" is displayed.
   - Forced end: "8" is displayed.

2) When tuning ended normally

   For PU operation or combined operation 2, press the STOP RESET key. For external operation or combined operation 1, switch off the start signal (STF or STR) once. This operation resets the offline auto tuning and the PU's monitor display returns to the ordinary indication. (Without this operation, next operation cannot be done.)
   Do not change the Pr.96 setting after completion of tuning (3). If the Pr.96 setting is changed, tuning data is made invalid. If the Pr.96 setting is changed, tuning must be performed again.

3) When tuning was ended due to an error

   Offline auto tuning did not end normally. (The motor constants have not been set.) Reset the inverter and start tuning all over again.

4) Error display definitions

Error Display	Error Cause	Remedy
9	Inverter trip	Make setting again.
91	Current limit (stall prevention) function was activated.	Increase acceleration/deceleration time. Set "1" in Pr. 156.
92	Converter output voltage reached 75% of rated value.	Check for fluctuation of power supply voltage.
93	Calculation error	Check the motor wiring and make setting again.

No connection with motor will result in a calculation (93) error.

5) When tuning was forced to end

An forced end occurs when you forced the tuning to end by pressing the STOP RESET key or switching off the start signal (STF or STR) during tuning.
In this case, the offline auto tuning has not ended normally.
(The motor constants are not set.)
Reset the inverter and restart the tuning.

Note: 1. The R1 motor constant measured during the offline auto tuning is stored as a parameter and its data is held until the offline auto tuning is performed again.
2. An instantaneous power failure occurring during tuning will result in a tuning error.
After power is restored, the inverter goes into the ordinary operation mode. Therefore, when STF (STR) is on, the motor runs in forward (reverse) rotation.
3. Any alarm occurring during tuning is handled as in the ordinary mode. Note that if an error retry has been set, retry is ignored.
4. The set frequency monitor displayed during the offline auto tuning is 0Hz.

⚠ CAUTION

⚠ **When the offline auto tuning is used for an elevating machine, e.g. a lifter, it may drop due to insufficient torque.**

<Setting the motor constant as desired>

- To set the motor constant without using the offline auto tuning data

<Operating procedure>

1. Set any of the following values in Pr. 71:

		Star Connection Motor	Delta Connection Motor
Setting	Standard motor	5 or 105	6 or 106
	Constant-torque motor	15 or 115	16 or 116

By setting any of "105 to 116", the electronic thermal relay function changes to the thermal characteristics of the constant-torque motor when the RT signal switches on.

2. Set "801" in Pr. 77.
   (Only when the Pr. 80 setting is other than "9999", the parameter values of the motor excitation current (Pr. 82) and motor constant (Pr. 90) can be displayed. Though the parameters other than Pr. 82 and Pr. 90 can also be displayed, they are parameters for manufacturer setting and their values should not be changed.)
3. In the parameter setting mode, read the following parameters and set desired values:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
82	Motor excitation current	0 to 500A, 9999	0.01A	9999
90	Motor constant (R1)	0 to 50Ω, 9999	0.001Ω	9999

4. Return the Pr. 77 setting to the original value.
5. Refer to the following table and set Pr. 84:

Parameter Number	Name	Setting Range	Setting Increments	Factory Setting
84	Rated motor frequency	50 to 120Hz	0.01Hz	60Hz

Note: 1. The Pr. 90 value may only be read when general-purpose magnetic flux vector control has been selected.
2. Set "9999" in Pr. 90 to use the standard motor constant (including that for the constant-torque motor).
3. If "star connection" is mistaken for "delta connection" or vice versa during setting of Pr. 71, general-purpose magnetic flux vector control cannot be exercised normally.

4.2.36 Computer link operation (Pr. 117 to Pr. 124, Pr. 342)

Pr. 117 "communication station number"
Pr. 118 "communication speed"
Pr. 119 "stop bit length"
Pr. 120 "parity check presence/absence"
Pr. 121 "number of communication retries"
Pr. 122 "communication check time interval"
Pr. 123 "waiting time setting"
Pr. 124 "CR • LF presence/absence selection"
Pr. 342 "E^{2}PROM write selection"

Used to perform required settings for RS-485 communication between the inverter and personal computer.

- **The motor can be run from the PU connector of the inverter using RS-485 communication.**

Communication specifications

Conforming standard			EIA-485(RS-485)
Number of inverters connected			1:N (maximum 32 inverters)
Communication speed			Selectable between 19200, 9600 and 4800bps
Control protocol			Asynchronous
Communication method			Half-duplex
Communication specifications	Character system		ASCII (7 bits/8 bits) selectable
	Stop bit length		Selectable between 1 bit and 2 bits.
	Terminator		CR/LF (presence/absence selectable)
	Check system	Parity check	Selectable between presence (even/odd) and absence
		Sum check	Present
	Waiting time setting		Selectable between presence and absence

- **For the instruction codes of the parameters, refer to Appendix 1 "Instruction Code List" (page 196).**

REMARKS

For computer link operation, set 65520 (HFFF0) as the value "8888" and 65535 (HFFFF) as the value "9999".

Parameter Number	Factory Setting	Setting Range	
117	0	0 to 31	
118	192	48, 96, 192	
119	1	Data length 8	0, 1
		Data length 7	10, 11
120	2	0, 1, 2	
121	1	0 to 10, 9999	
122*	9999	0, 0.1 to 999.8 s, 9999	
123	9999	0 to 150, 9999	
124	1	0, 1, 2	
342	0	0, 1	

* When making communication, set any value other than 0 in Pr. 122 "communication check time interval".

<Setting>

To make communication between the personal computer and inverter, the communication specifications must be set to the inverter initially. If initial setting is not made or there is a setting fault, data transfer cannot be made.

Note: After making the initial setting of the parameters, always reset the inverter. After you have changed the communication-related parameters, communication cannot be made until the inverter is reset.

Parameter Number	Name	Setting		Description
117	Communication station number	0 to 31		Station number specified for communication from the PU connector. Set the inverter station numbers when two or more inverters are connected to one personal computer.
118	Communication speed	48		4800bps
		96		9600bps
		192		19200bps
119	Stop bit length	8 bits	0	Stop bit length 1 bit
			1	Stop bit length 2 bits
		7 bits	10	Stop bit length 1 bit
			11	Stop bit length 2 bits
120	Parity check presence/ absence	0		Absent
		1		Odd parity present
		2		Even parity present
121	Number of communication retries	0 to 10		Set the permissible number of retries at occurrence of a data receive error. If the number of consecutive errors exceeds the permissible value, the inverter will come to an alarm stop.
		9999 (65535)		If a communication error occurs, the inverter will not come to an alarm stop. At this time, the inverter can be coasted to a stop by MRS or RES input. During a communication error (H0 to H5), the minor fault signal (LF) is switched on. Allocate the used terminal with any of Pr. 190 to Pr. 192 (multi-function outputs).

Parameter Number	Name	Setting	Description
122	Communication check time interval	0	No communication
		0.1 to 999.8	Set the communication check time [seconds] interval. If a no-communication state persists for longer than the permissible time, the inverter will come to an alarm stop.
		9999	Communication check suspension
123	Waiting time setting	0 to 150	Set the waiting time between data transmission to the inverter and response.
		9999	Set with communication data.
124	CR • LF instruction presence/ absence	0	Without CR/LF
		1	With CR, without LF
		2	With CR/LF
342*	E^2PROM write selection	0	When parameter write is performed from the computer, parameters are written to E^2PROM.
		1	When parameter write is performed from the computer, parameters are written to RAM.

* When you have set write to RAM, powering off the inverter clears the parameter values that have been changed. Therefore the parameter values available when power is switched on again are those stored previously in E^2PROM.
When the parameter values will be changed frequently, set "1" in Pr. 342 to choose write to RAM. Performing frequent parameter write with "E^2PROM write" set will shorten the life of the E^2PROM.
The Pr. 342 " E^2PROM write selection" setting is also valid when the communication option is fitted.

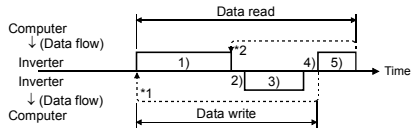
REMARKS

When parameter is set to without E^2PROM write (Pr.342="1"), performing power reset or terminal reset returns the setting value to the original value (value stored in E^2PROM).

<Computer programming>

(1) Communication protocol

Data communication between the computer and inverter is performed using the following procedure:



*1. If a data error is detected and a retry must be made, execute retry operation with the user program. The inverter comes to an alarm stop if the number of consecutive retries exceeds the parameter setting.
*2. On receipt of a data error occurrence, the inverter returns "reply data 3)" to the computer again. The inverter comes to an alarm stop if the number of consecutive data errors reaches or exceeds the parameter setting.

(2) Communication operation presence/absence and data format types

Communication operation presence/absence and data format types are as follows:

No.	Operation		Run Command	Running Frequency	Parameter Write	Inverter Reset	Monitoring	Parameter Read
1)	Communication request is sent to the inverter in accordance with the user program in the computer.		A'	A (A") Note 1	A (A") Note 2	A	B	B
2)	Inverter data processing time		Present	Present	Present	Absent	Present	Present
3)	Reply data from the inverter (Data 1) is checked for error.	No error* (Request accepted)	C	C	C	Absent	E,E' (E") Note 1	E (E") Note 2
		With error (request rejected)	D	D	D	Absent	F	F
4)	Computer processing delay time		Absent	Absent	Absent	Absent	Absent	Absent
5)	Answer from computer in response to reply data 3). (Data 3) is checked for error)	No error* (No inverter processing)	Absent	Absent	Absent	Absent	G	G
		With error. (Inverter outputs 3) again)	Absent	Absent	Absent	Absent	H	H

* In the communication request data from the computer to the inverter, 10ms or more is also required after "no data error (ACK)". (Refer to page 128.)

Note: 1. Setting any of "0.01 to 9998" in Pr. 37 "speed display" and "1" in instruction code "HFF" changes the data format to A" or E". The output frequency is the value of the speed display and its unit is 0.001r/min. If the instruction code FF is not 1, the unit is 1r/min and the 4-digit data format can be used.
2. The read/write data format of Pr. 37 "speed display" is always E"/A".

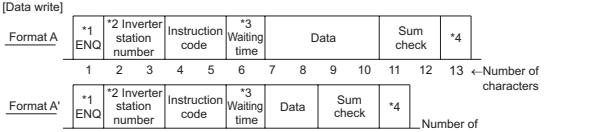
(3) Data format

Data used is hexadecimal.
Data is automatically transferred in ASCII between the computer and inverter.

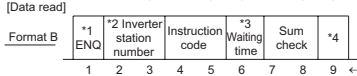
• Data format types

1) Communication request data from computer to inverter

[Data write]

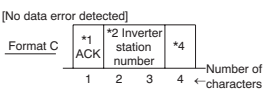


[Data read]

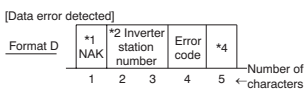


2) Reply data from inverter to computer during data write

[No data error detected]

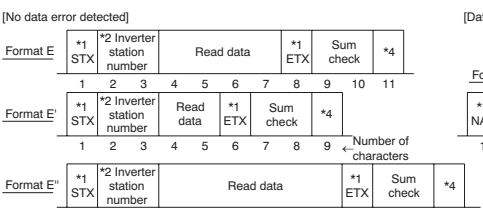


[Data error detected]

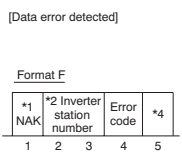


3) Reply data from inverter to computer during data read

[No data error detected]

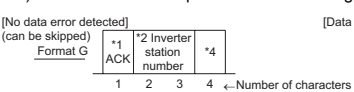


[Data error detected]

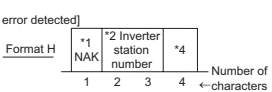


4) Send data from computer to inverter during data read

[No data error detected]
(can be skipped)



[Data error detected]



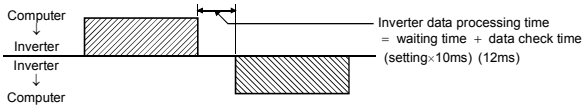
*1. Indicate a control code. (Refer to (4) Data definitions.)
*2. The inverter station numbers may be set between H00 and H1F (stations 0 and 31) in hexadecimal.
*3. When the Pr. 123 "waiting time setting" setting is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters is decremented by 1.)
*4. CR, LF code
When data is transmitted from the computer to the inverter, codes CR (carriage return) and LF (line feed) are automatically set at the end of a data group on some computers. In this case, setting must also be made on the inverter according to the computer. Also, the presence and absence of the CR and LF codes can be selected using Pr. 124.

(4) Data definitions

1)Control codes

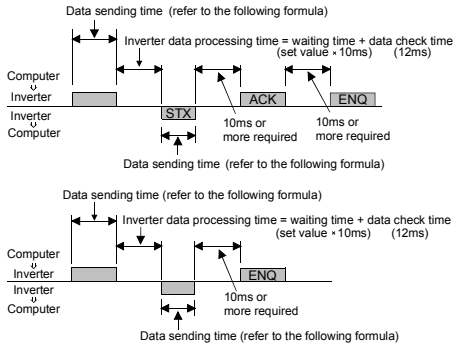
Signal	ASCII Code	Description
STX	H02	Start of Text (Start of data)
ETX	H03	End of Text (End of data)
ENQ	H05	Enquiry (Communication request)
ACK	H06	Acknowledge (No data error detected)
LF	H0A	Line Feed
CR	H0D	Carriage Return
NAK	H15	Negative Acknowledge (Data error detected)

2)Inverter station number
Specify the station number of the inverter which communicates with the computer.
3)Instruction code
Specify the processing request, e.g. operation, monitoring, given by the computer to the inverter. Hence, the inverter can be run and monitored in various ways by specifying the instruction code as appropriate. (Refer to page 196.)
4)Data
Indicates the data such as frequency and parameters transferred to and from the inverter. The definitions and ranges of set data are determined in accordance with the instruction codes. (Refer to page 196.)
5)Waiting time
Specify the waiting time between the receipt of data at the inverter from the computer and the transmission of reply data. Set the waiting time in accordance with the response time of the computer between 0 and 150ms in 10ms increments (e.g. 1 = 10ms, 2 = 20ms).



Note: When the Pr. 123 "waiting time setting" setting is other than "9999", create the communication request data without "waiting time" in the data format. (The number of characters is decremented by 1.)

6)Response time



[Formula for data sending time]

$$\frac{1}{\text{Communication speed (bps)}} \times \text{Number of data characters (Refer to page 126)} \times \text{Communication specification (Total number of bits) (See below)} = \text{Data sending time (s)}$$

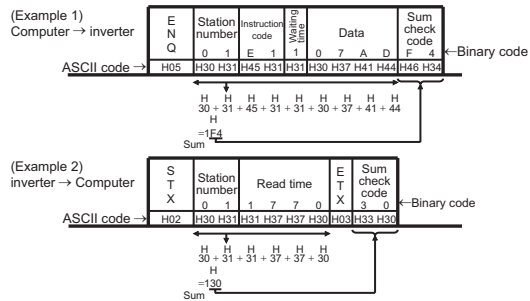
●Communication specification

Name		Number of Bits
Stop bit length		1 bit 2 bits
Data length		7 bits 8 bits
Parity check	Yes	1 bit
	No	0 bit

In addition to the bits in the above table, 1 bit is required for the start bit.
Minimum total number of bits..... 9 bits
Maximum total number of bits..... 12 bits

7)Sum check code

The sum check code is 2-digit ASCII (hexadecimal) representing the lower 1 byte (8 bits) of the sum (binary) derived from the checked ASCII data.



8)Error code

If any error is found in the data received by the inverter, its definition is sent back to the computer together with the NAK code. (Refer to page 133.)

Note: 1. When the data from the computer has an error, the inverter will not accept that data.
2. Any data communication, e.g. run command, monitoring, is started when the computer gives a communication request. Without the computer's command, the inverter does not return any data. For monitoring, therefore, design the program to cause the computer to provide a data read request as required.
3. When the parameter setting is read or written, the data of the link parameter expansion setting changes depending on the parameter. For the data, refer to the parameter instruction code list on page 196.

⚠ CAUTION

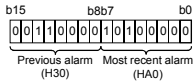
⚠ **When the inverter's permissible communication time interval is not set, interlocks are provided to disable operation to prevent hazardous conditions. Always set the communication check time interval before starting operation.**

⚠ **Data communication is not started automatically but is made only once when the computer provides a communication request. If communication is disabled during operation due to signal cable breakage etc, the inverter cannot be stopped. When the communication check time interval has elapsed, the inverter will come to an alarm stop (E.PUE).**
The inverter can be coasted to a stop by switching on its RES signal or by switching power off.

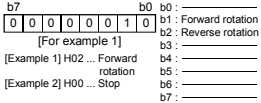
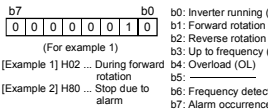
⚠ **If communication is broken due to signal cable breakage, computer fault etc, the inverter does not detect such a fault. This should be fully noted.**

<Setting items and set data>

After completion of parameter settings, set the instruction codes and data then start communication from the computer to allow various types of operation control and monitoring.

<table>
<tr><th>No.</th><th colspan="3">Item</th><th>Instruction Code</th><th>Description</th><th>Number of Data Digits (Instruction code FF=1)</th></tr>
<tr><td rowspan="2">1</td><td colspan="2" rowspan="2">Operation mode</td><td>Read</td><td>H7B</td><td>H0001: External operation
H0002: Communication operation</td><td rowspan="2">4 digits</td></tr>
<tr><td>Write</td><td>HFB</td><td>H0001: External operation
H0002: Communication operation</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Monitoring</td><td colspan="2">Output frequency [speed]</td><td>H6F</td><td>H0000 to HFFFF: Output frequency (hexadecimal) in 0.01Hz increments
[Speed (hexadecimal) in r/min increments if Pr. 37 = 1 to 9998]</td><td>4 digits
(6 digits)</td></tr>
<tr><td colspan="2">Output current</td><td>H70</td><td>H0000 to HFFFF: Output current (hexadecimal) in 0.01A increments</td><td>4 digits</td></tr>
<tr><td colspan="2">Output voltage</td><td>H71</td><td>H0000 to HFFFF: Output voltage (hexadecimal) in 0.1V increments</td><td>4 digits</td></tr>
<tr><td colspan="2">Alarm definition</td><td>H74 to H77</td><td>H0000 to HFFFF: Two most recent alarm definitions
Alarm definition display example (instruction code H74)
 

Alarm data
<table>
<tr><th>Data</th><th>Description</th></tr>
<tr><td>H00</td><td>No alarm</td></tr>
<tr><td>H10</td><td>OC1</td></tr>
<tr><td>H11</td><td>OC2</td></tr>
<tr><td>H12</td><td>OC3</td></tr>
<tr><td>H20</td><td>OV1</td></tr>
<tr><td>H21</td><td>OV2</td></tr>
<tr><td>H22</td><td>OV3</td></tr>
<tr><td>H30</td><td>THT</td></tr>
<tr><td>H31</td><td>THM</td></tr>
<tr><td>H40</td><td>FIN</td></tr>
<tr><td>H60</td><td>OLT</td></tr>
<tr><td>H70</td><td>BE</td></tr>
</table>
<table>
<tr><th>Data</th><th>Description</th></tr>
<tr><td>H80</td><td>GF</td></tr>
<tr><td>H81</td><td>LF</td></tr>
<tr><td>H90</td><td>OHT</td></tr>
<tr><td>HA0</td><td>OPT</td></tr>
<tr><td>HB0</td><td>PE</td></tr>
<tr><td>HB1</td><td>PUE</td></tr>
<tr><td>HB2</td><td>RET</td></tr>
<tr><td>HC2</td><td>P24</td></tr>
<tr><td>HF3</td><td>E. 3</td></tr>
<tr><td>HF6</td><td>E. 6</td></tr>
<tr><td>HF7</td><td>E. 7</td></tr>
</table></td><td>4 digits</td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Instruction Code</th><th>Description</th><th>Number of Data Digits (Instruction code FF=1)</th></tr>
<tr><td>3</td><td>Run command</td><td>HFA</td><td> 
</td><td>2 digits</td></tr>
<tr><td>4</td><td>Inverter status monitor</td><td>H7A</td><td> 
</td><td>2 digits</td></tr>
<tr><td rowspan="4">5</td><td>Set frequency read (RAM)</td><td>H6D</td><td rowspan="2">Reads the set frequency (RAM or E^{2}PROM). H0000 to H9C40: 0.01Hz increments (hexadecimal)</td><td rowspan="2">4 digits (6 digits)</td></tr>
<tr><td>Set frequency read (E^{2}PROM)</td><td>H6E</td></tr>
<tr><td>Set frequency write (RAM)</td><td>HED</td><td rowspan="2">H0000 to H9C40: 0.01Hz increments (hexadecimal) (0 to 400.00Hz)
To change the set frequency consecutively, write data to the inverter RAM. (Instruction code: HED)</td><td rowspan="2">4 digits (6 digits)</td></tr>
<tr><td>Set frequency write (E^{2}PROM)</td><td>HEE</td></tr>
<tr><td>6</td><td>Inverter reset</td><td>HFD</td><td>H9696: Resets the inverter.
As the inverter is reset on start of communication by the computer, the inverter cannot send reply data back to the computer.</td><td>4 digits</td></tr>
<tr><td>7</td><td>Alarm definition batch clear</td><td>HF4</td><td>H9696: Batch clear of alarm history</td><td>4 digits</td></tr>
<tr><td>8</td><td>All parameter clear</td><td>HFC</td><td>All parameters return to the factory settings.
Any of four different all clear operations is performed according to the data.
<table>
<tr><th>Pr. / Data</th><th>Communication Pr.</th><th>Calibration</th><th>Other Pr.*</th><th>HEC HFF</th></tr>
<tr><td>H9696</td><td>O</td><td>×</td><td>O</td><td>O</td></tr>
<tr><td>H9966</td><td>O</td><td>O</td><td>O</td><td>O</td></tr>
<tr><td>H5A5A</td><td>×</td><td>×</td><td>O</td><td>O</td></tr>
<tr><td>H55AA</td><td>×</td><td>O</td><td>O</td><td>O</td></tr>
</table>
When all parameter clear is executed for H9696 or H9966, communication-related parameter settings also return to the factory settings. When resuming operation, set the parameters again.
* Pr. 75 is not cleared.</td><td>4 digits</td></tr>
</table>

No.	Item		Instruction Code	Description	Number of Data Digits (Instruction code FF=1)
9	Parameter write		H80 to HFD	Refer to the "Instruction Code List" (page 196) and write and/or read the values as required.	4 digits
10	Parameter read		H00 to H7B		
11	Link parameter expansion setting	Read	H7F	Parameter description is changed according to the H00 to H09 setting. For details of the settings, refer to the parameter instruction code list (page 196).	2 digits
		Write	HFF		
12	Second parameter changing (Instruction code HFF = 1)	Read	H6C	When setting the bias/gain (instruction codes H5E to H61, HDE to HE1) parameters H00: Offset/gain H01: Analog H02: Analog value of terminal	2 digits
		Write	HEC		

REMARKS

For the instruction codes HFF, HEC, their set values are held once they are written, but changed to 0 when the inverter is reset or all clear is performed.

<Error Code List>

The corresponding error code in the following list is displayed if an error is detected in any communication request data from the computer:

Error Code	Item	Definition	Inverter Operation
H0	Computer NAK error	The number of errors consecutively detected in communication request data from the computer is greater than allowed number of retries.	Brought to an alarm stop (E.PUE) if error occurs continuously more than the allowable number of retries.
H1	Parity error	The parity check result does not match the specified parity.	
H2	Sum check error	The sum check code in the computer does not match that of the data received by the inverter.	
H3	Protocol error	Data received by the inverter is in wrong protocol, data receive is not completed within given time, or CR and LF are not as set in the parameter.	
H4	Framing error	The stop bit length is not as specified by initialization.	
H5	Overrun error	New data has been sent by the computer before the inverter completes receiving the preceding data.	
H6	—	—	—
H7	Character error	The character received is invalid (other than 0 to 9, A to F, control code).	Does not accept received data but is not brought to an alarm stop.
H8	—	—	—
H9	—	—	—
HA	Mode error	Parameter write was attempted in other than the computer link operation mode or during inverter operation.	Does not accept received data but is not brought to an alarm stop.
HB	Instruction code error	The specified command does not exist.	
HC	Data range error	Invalid data has been specified for parameter write, frequency setting, etc.	
HD	—	—	—
HE	—	—	—
HF	—	—	—

(5) Communication specifications for RS-485 communication

Operation Location	Item	Operation Mode	
		Communication Operation from PU Connector	External Operation
Computer user program via PU connector	Run command (start)	Enabled	Disabled
	Running frequency setting	Enabled	Enabled (Combined operation mode)
	Monitoring	Enabled	Enabled
	Parameter write	Enabled (*2)	Disabled (*2)
	Parameter read	Enabled	Enabled
	Inverter reset	Enabled	Enabled
	Stop command (*1)	Enabled	Enabled
Control circuit terminal	Inverter reset	Enabled	Enabled
	Run command	Disabled	Enabled
	Running frequency setting	Disabled	Enabled

*1. As set in Pr. 75 "reset selection/disconnected PU detection/PU stop selection".
*2. As set in Pr. 77 "parameter write disable selection".

Note: At occurrence of RS-485 communication fault, the inverter cannot be reset from the computer.

(6) Operation at alarm occurrence

Fault Location	Status		Operation Mode	
			Communication Operation (PU connector)	External Operation
Inverter fault	Inverter operation		Stop	Stop
	Communication	PU connector	Continued	Continued
Communication error (Communication from PU connector)	Inverter operation		Stop/continued (*3)	Continued
	Communication	PU connector	Stop	Stop

*3. Can be selected using the corresponding parameter (factory-set to stop).

(7) Communication error

Fault Location	Error Message	Remarks
Communication error (Error in communication from PU connector)	Not displayed	Error code is E.PUE

4.2.37 PID control (Pr. 128 to Pr. 134)

Pr. 128 "PID action selection"

Pr. 129 "PID proportional band"

Pr. 130 "PID integral time"

Pr. 131 "upper limit"

Pr. 132 "lower limit"

Pr. 133 "PID action set point for PU operation"

Pr. 134 "PID differential time"

Related parameters
Pr. 73 "0-5V/0-10V selection"
Pr. 79 "operation mode selection"
Pr. 180 to Pr. 183 (input terminal function selection)
Pr. 190 to Pr. 192 (output terminal function selection)
Pr. 902 to Pr. 905 (frequency setting voltage (current) biases and gains)

The inverter can be used to exercise process control, e.g. flow rate, air volume or pressure.

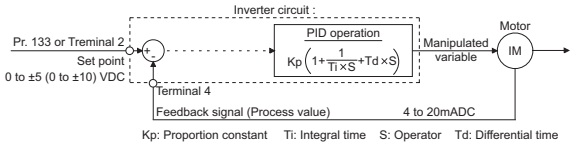
- The voltage input signal (0 to ±5V or 0 to ±10V) or Pr. 133 setting is used as a set point and the 4 to 20mA DC current input signal used as a feedback value to constitute a feedback system for PID control.

Parameter Number	Factory Setting	Setting Range	Remarks
128	0	0, 20, 21, 50, 51, 60, 61 *	
129	100%	0.1 to 1000%, 9999	9999: No proportional control
130	1s	0.1 to 3600s, 9999	9999: No integral control
131	9999	0 to 100%, 9999	9999: Function invalid
132	9999	0 to 100%, 9999	9999: Function invalid
133	0%	0 to 100%	
134	9999	0.01 to 10.00s, 9999	9999: No differential control

* "50, 51, 60, 61" can be set when used with the FR-E5NL.

<Setting>

(1) Basic PID control configuration



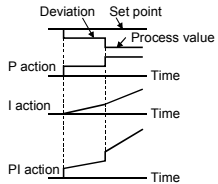
(2) PID action overview

1) PI action

A combination of proportional control action (P) and integral control action (I) for providing a manipulated variable in response to deviation and changes with time.

[Operation example for stepped changes of process value]

Note: PI action is the sum of P and I actions.

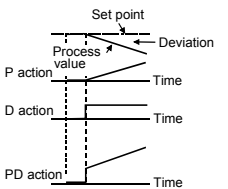


2) PD action

A combination of proportional control action (P) and differential control action (D) for providing a manipulated variable in response to deviation speed to improve the transient characteristic.

[Operation example for proportional changes of process value]

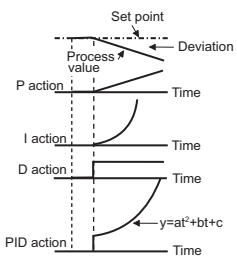
Note: PD action is the sum of P and D actions.



3) PID action

The PI action and PD action are combined to utilize the advantages of both actions for control.

Note: The PID action is the sum of the P, I and D actions.

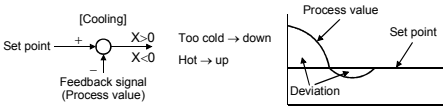


4) Reverse action

Increases the manipulated variable (output frequency) if deviation X = (set point - process value) is positive, and decreases the manipulated variable if deviation is negative.

5) Forward action

Increases the manipulated variable (output frequency) if deviation X = (set point - process value) is negative, and decreases the manipulated variable if deviation is positive.



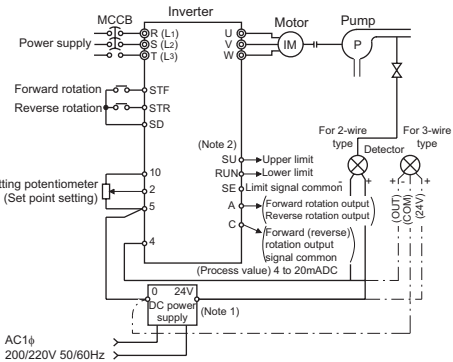
Relationships between deviation and manipulated variable (output frequency)

	Deviation	
	Positive	**Negative**
Reverse action	↗	↘
Forward action	↘	↗

4

(3) Wiring example

- Pr. 128 = 20
- Pr. 190 = 14
- Pr. 191 = 15
- Pr. 192 = 16



Note: 1. The power supply must be selected in accordance with the power specifications of the detector used.
2. The output signal terminals used depends on the Pr. 190 to Pr. 192 settings.

(4) I/O signals

Signal		Terminal Used	Function	Description
Input	2	2	Set point input	Enter the set point for PID control.
	4	4	Process value input	Enter the 4 to 20mA process value signal from the detector.
Output	FUP	Depending on Pr. 190 to Pr. 192	Upper limit output	Output to indicate that the process value signal exceeded the upper limit value.
	FDN		Lower limit output	Output to indicate that the process value signal exceeded the lower limit value.
	RL		Forward (reverse) rotation direction output	"Hi" is output to indicate that the output indication of the parameter unit is forward rotation (FWD) or "Low" to indicate that it is reverse rotation (REV) or stop (STOP).

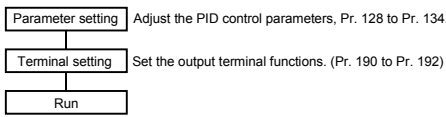
- Enter the set point across inverter terminals 2-5 or in Pr. 133 and enter the process value signal across inverter terminals 4-5. At this time, set "20" or "21" in Pr. 128.

Item	Entry	Description	
Set point	Across terminals 2-5	Set 0V as 0% and 5V as 100%.	When "0" or "10" is set in Pr. 73 (5V selected for terminal 2).
		Set 0V as 0% and 10V as 100%.	When "1" or "11" is set in Pr. 73 (10V selected for terminal 2).
	Pr. 133	Set the set point (%) in Pr. 133.	
Process value	Across terminals 4-5	4mA is equivalent to 0% and 20mA to 100%.	

(5) Parameter setting

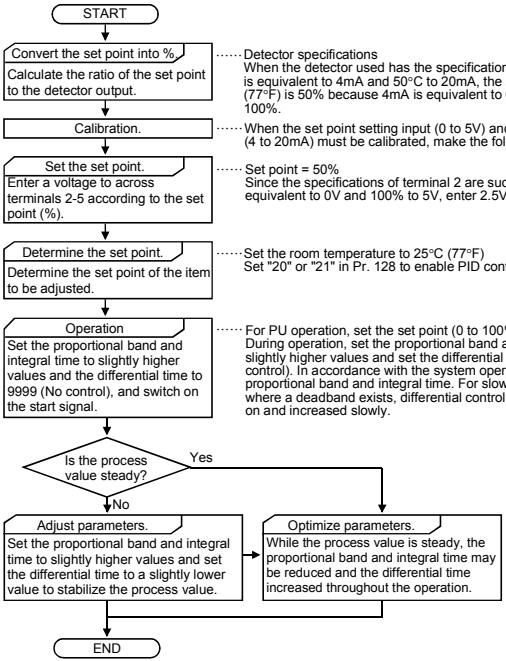
Parameter Number	Setting	Name	Description	
128	0	PID action selection	No PID action	
	20		For heating, pressure control, etc.	PID reverse action
	21		For cooling, etc.	PID forward action
	50		Refer to the E5NL instruction manual for details.	
	51			
	60			
	61			
129	0.1 to 1000%	PID proportional band	If the proportional band is narrow (parameter setting is small), the manipulated variable varies greatly with a slight change of the process value. Hence, as the proportional band narrows, the response sensitivity (gain) improves but the stability deteriorates, e.g. hunting occurs. Gain K = 1/proportional band	
	9999		No proportional control	
130	0.1 to 3600 s	PID integral time	Time required for the integral (I) action to provide the same manipulated variable as that for the proportional (P) action. As the integral time decreases, the set point is reached earlier but hunting occurs more easily.	
	9999		No integral control.	
131	0 to 100%	Upper limit	Set the upper limit. If the feedback value exceeds the setting, the FUP signal is output. (Process value of 4mA is equivalent to 0% and 20mA to 100%.)	
	9999		No function	
132	0 to 100%	Lower limit	Set the lower limit. (If the feedback value falls below the setting, the FDN signal is output. Process value of 4mA is equivalent to 0% and 20mA to 100%.)	
	9999		No function	
133	0 to 100%	PID action set point for PU operation	Only valid for the PU command in the PU operation or PU/external combined operation mode. For external operation, the voltage across 2-5 is the set point. (Pr. 902 value is equivalent to 0% and Pr. 903 value to 100%.)	
134	0.01 to 10.00 s	PID differential time	Time required for the differential (D) action to provide the same process value as that for the proportional (P) action. As the differential time increases, greater response is made to the deviation change.	
	9999		No differential control.	

(6) Adjustment procedure


Parameter setting
Adjust the PID control parameters, Pr. 128 to Pr. 134.
Terminal setting
Set the output terminal functions. (Pr. 190 to Pr. 192)
Run

(7) Calibration example

(A detector of 4mA at 0°C (32°F) and 20mA at 50°C (122°F) is used to adjust the room temperature to 25°C (77°F) under PID control. The set point is given to across inverter terminals 2-5 (0-5V).)


START
Convert the set point into %.
Calculate the ratio of the set point to the detector output.
Detector specifications
When the detector used has the specifications that 0°C (32°F) is equivalent to 4mA and 50°C to 20mA, the set point of 25°C (77°F) is 50% because 4mA is equivalent to 0% and 20mA to 100%.
Calibration.
When the set point setting input (0 to 5V) and detector output (4 to 20mA) must be calibrated, make the following calibration*.
Set the set point.
Enter a voltage to across terminals 2-5 according to the set point (%).
Set point = 50%
Since the specifications of terminal 2 are such that 0% is equivalent to 0V and 100% to 5V, enter 2.5V into terminal 2.
Determine the set point.
Determine the set point of the item to be adjusted.
Set the room temperature to 25°C (77°F)
Set "20" or "21" in Pr. 128 to enable PID control.
Operation
Set the proportional band and integral time to slightly higher values and the differential time to 9999 (No control), and switch on the start signal.
For PU operation, set the set point (0 to 100%) in Pr. 133.
During operation, set the proportional band and integral time to slightly higher values and set the differential time to 9999 (No control). In accordance with the system operation, reduce the proportional band and integral time. For slow response system where a deadband exists, differential control shuold be turned on and increased slowly.
Is the process value steady?
Yes
No
Adjust parameters.
Set the proportional band and integral time to slightly higher values and set the differential time to a slightly lower value to stabilize the process value.
Optimize parameters.
While the process value is steady, the proportional band and integral time may be reduced and the differential time increased throughout the operation.
END

* When calibration is required, use Pr. 902 and Pr. 903 (terminal 2) or Pr. 904 and Pr. 905 (terminal 4) to calibrate the detector output and set point setting input in the PU mode during an inverter stop.

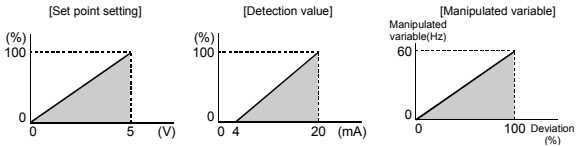
<Set point input calibration>

1. Apply the input voltage of 0% set point setting (e.g. 0V) to across terminals 2-5.
2. Make calibration using Pr. 902. At this time, enter the frequency which should be output by the inverter at the deviation of 0% (e.g. 0Hz).
3. Apply the voltage of 100% set point setting (e.g. 5V) to across terminals 2-5.
4. Make calibration using Pr. 903. At this time, enter the frequency which should be output by the inverter at the deviation of 100% (e.g. 60Hz).

<Detector output calibration>

1. Apply the output current of 0% detector setting (e.g. 4mA) across terminals 4-5.
2. Make calibration using Pr. 904.
3. Apply the output current of 100% detector setting (e.g. 20mA) across terminals 4-5.
4. Make calibration using Pr. 905.

Note: The frequencies set in Pr. 904 and Pr. 905 should be the same as set in Pr. 902 and Pr. 903.
The results of the above calibration are as shown below:



Note: 1. Entering multi-speed (RH, RM, RL signal) or JOG operation will stop PID control and start multi-speed or JOG operation.
2. When the terminal functions are changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.
3. When you have chosen the PID control, the minimum frequency is as set in Pr. 902 and the maximum frequency is as set in Pr. 903.
(The settings of Pr. 1 "maximum frequency" and Pr. 2 "minimum frequency" are also valid.)

4.2.38 Output current detection function (Pr. 150, Pr. 151)

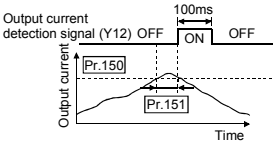
Pr. 150 "output current detection level"

Pr. 151 "output current detection period"

Related parameters
Pr. 190 to Pr. 192 (output terminal function selection)

- If the output current remains higher than the Pr. 150 setting during inverter operation for longer than the time set in Pr. 151, the output current detection signal (Y12) is output from the inverter's open collector output terminal.
  (Use any of Pr. 190 to Pr. 192 to assign the terminal used for Y12 signal output.)

Parameter Number	Factory Setting	Setting Range
150	150%	0 to 200.0%
151	0s	0 to 10 s



<Setting>

Refer to the following list and set the parameters:

Parameter Number	Description
150	Set the output current detection level. 100% is the rated inverter current.
151	Set the output current detection time. Set a period of time from when the output current rises to or above the Pr. 150 setting to when the output current detection signal (Y12) is output.

Note: 1. Once turned ON, when the output current has risen above the preset detection level, the output current detection signal is held for at least 100ms (approximately).
2. This function is also valid during execution of offline auto tuning.
3. When the terminal functions are changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

4.2.39 Zero current detection (Pr. 152, Pr. 153)

Pr. 152 "zero current detection level"

Pr. 153 "zero current detection period"

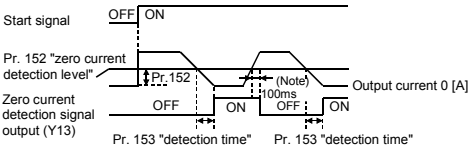
Related parameters
Pr. 190 to Pr. 192 (output terminal function selection)

When the inverter's output current falls to "0", torque will not be generated. This may cause a gravity drop when the inverter is used in vertical lift application.

To prevent this, the output current "zero" signal can be output from the inverter to close the mechanical brake when the output current has fallen to "zero".

- If the output current remains lower than the Pr. 152 setting during inverter operation for longer than the time set in Pr. 153, the zero current detection (Y13) signal is output from the inverter's open collector output terminal.
  (Use any of Pr. 190 to Pr. 192 to assign the terminal used for Y13 signal output.)

Parameter Number	Factory Setting	Setting Range
152	5.0%	0 to 200.0%
153	0.5 s	0.05 to 1 s



<Setting>

Refer to the following list and set the parameters:

Parameter Number	Description
152	Set the zero current detection level. Set this parameter to define the percentage of the rated current at which the zero current will be detected.
153	Set the zero current detection time. Set a period of time from when the output current falls to or below the Pr. 152 setting to when the zero current detection signal (Y13) is output.

Note: 1. If the current rises above the preset detection level but the timing condition is not satisfied, the zero current detection signal is held on for about 100ms.
2. This function is also valid during execution of offline auto tuning.
3. When the terminal functions are changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

⚠ CAUTION

⚠ **The zero current detection level setting should not be too high, and the zero current detection time setting should not be too long. Otherwise, the detection signal may not be output when torque is not generated at a low output current.**

⚠ **To prevent the machine and equipment from resulting in hazardous conditions by use of the zero current detection signal, install a safety backup such as an emergency brake.**

Pr. 156 ➔Refer to Pr. 22.

Pr. 158 ➔Refer to Pr. 52.

4.2.40 User group selection (Pr. 160, Pr. 173 to Pr. 176)

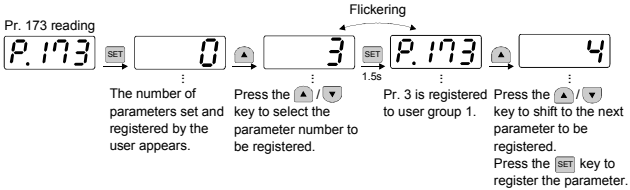
Pr. 160 "user group read selection"
Pr. 173 "user group 1 registration"
Pr. 174 "user group 1 deletion"
Pr. 175 "user group 2 registration"
Pr. 176 "user group 2 deletion"

Among all parameters, a total of 32 parameters can be registered to two different user groups. The registered parameters may only be accessed.
The other parameters cannot be read.

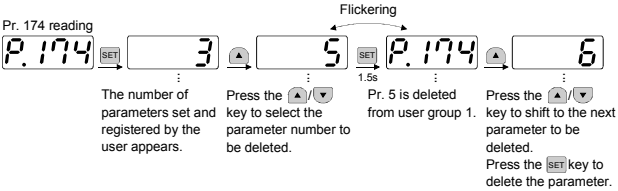
Parameter Number	Factory Setting	Setting Range	Remarks
160	0	0, 1, 10, 11	
173	0	0 to 999	
174	0	0 to 999, 9999	9999: Batch deletion
175	0	0 to 999	
176	0	0 to 999, 9999	9999: Batch deletion

<Setting examples show the use of the operation panel (FR-PA02-02)>

(1) Registration of parameter to user group (when registering Pr. 3 to user group 1)


Pr. 173 reading
Flickering
SET
1.5s
The number of parameters set and registered by the user appears.
Press the ▲/▼ key to select the parameter number to be registered.
Pr. 3 is registered to user group 1.
Press the ▲/▼ key to shift to the next parameter to be registered.
Press the SET key to register the parameter.

(2) Deletion of parameter from the user group (when Pr. 5 is deleted from user group 1)


Pr. 174 reading
Flickering
SET
1.5s
The number of parameters set and registered by the user appears.
Press the ▲/▼ key to select the parameter number to be deleted.
Pr. 5 is deleted from user group 1.
Press the ▲/▼ key to shift to the next parameter to be deleted.
Press the SET key to delete the parameter.

(3) Set the required value in Pr. 160 to make the user group or groups valid or invalid.

Pr. 160 Setting	Description
0	Accessible to all parameters.
1	Accessible to only the parameters registered to user group 1.
10	Accessible to only the parameters registered to user group 2.
11	Accessible to only the parameters registered to user groups 1 and 2.

Note: 1. The Pr. 77, Pr. 160 and Pr. 991 values may always be read independently of the user group setting.
2. The Pr. 173 or Pr. 174 value read indicates the number of parameters registered to group 1, and the Pr. 175 or Pr. 176 value read indicates the number of parameters registered to group 2.
3. If "0" is set in the second digit of two-digit Pr. 160, it is not displayed. However, "0" is displayed when it is set in the first digit only.
4. When "9999" is set in Pr. 174 or Pr. 176, the parameters registered to the corresponding user group are batch-deleted.

4.2.41 Actual operation hour meter clear (Pr. 171)

Pr. 171 "actual operation hour meter clear"

Related parameter
Pr. 52 "operation panel/PU main display data selection"

You can clear the monitor (actual operation hour) value which is selected when Pr. 52 is "23".

Parameter Number	Factory Setting	Setting Range
171	0	0

<Setting>

Write "0" in the parameter to clear the actual operation hour.

Pr. 173 to Pr. 176 ➔Refer to Pr. 160.

4.2.42 Input terminal function selection (Pr. 180 to Pr. 183)

Pr. 180 "RL terminal function selection"

Pr. 181 "RM terminal function selection"

Pr. 182 "RH terminal function selection"

Pr. 183 "MRS terminal function selection"

Use these parameters to select/change the input terminal functions.

Parameter Number	Terminal Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range
180	RL	0	Low-speed operation command (RL)	0 to 8, 16, 18
181	RM	1	Middle-speed operation command (RM)	0 to 8, 16, 18
182	RH	2	High-speed operation command (RH)	0 to 8, 16, 18
183	MRS	6	Output shut-off (MRS)	0 to 8, 16, 18

<Setting>

Refer to the following list and set the parameters.

Setting	Signal Name	Function		Related Parameters
0	RL	Pr. 59 = 0	Low-speed operation command	Pr. 4 to Pr. 6 Pr. 24 to Pr. 27 Pr. 232 to Pr. 239
		Pr. 59 = 1, 2 *	Remote setting (setting clear)	Pr. 59
1	RM	Pr. 59 = 0	Middle-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
		Pr. 59 = 1, 2 *	Remote setting (deceleration)	Pr. 59
2	RH	Pr. 59 = 0	High-speed operation command	Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
		Pr. 59 = 1, 2 *	Remote setting (acceleration)	Pr. 59
3	RT	Second function selection		Pr. 44 to Pr. 48
4	AU	Current input selection (Note 6)		
5	STOP	Start self-holding terminal		
6	MRS	Output shut-off terminal		
7	OH	External thermal relay input ** The external thermal relay provided for overheat protection or the embedded temperature relay within the motor is activated to stop the inverter.		Refer to page 167
8	REX	15-speed selection (combination with three speeds of RL, RM, RH)		Pr. 4 to Pr. 6, Pr. 24 to Pr. 27, Pr. 232 to Pr. 239
16	X16	PU operation-external operation switch-over		Pr. 79
18	X18	General-purpose magnetic flux vector-V/F switch-over (OFF: general-purpose magnetic flux vector control, ON: V/F control) (Note 3)		Pr. 80

* : When Pr. 59 = "1" or "2", the functions of the RL, RM and RH signals change as listed above.

**: Activated when the relay contact "opens".

Note: 1. One function can be assigned to two or more terminals. In this case, the terminal inputs are OR' ed.
2. The speed command priorities are higher in order of multi-speed setting (RH, RM, RL, REX) and AU.
3. When V/F control is selected using the V/F-general-purpose magnetic flux switch-over function, the secondary functions are also selected.
During operation, you cannot switch between V/F and general-purpose magnetic flux. Should you switch between V/F and general-purpose magnetic flux, only the second functions are selected.
4. Use common terminals to assign multi-speeds (7 speeds) and remote setting. They cannot be set individually.
(Common terminals are used since these functions are designed for multiple speed setting and need not be set at the same time.)
5. Functions are invalid if values other than the above are set to Pr. 180 to Pr. 183 (input terminal function selection).
6. Turning the AU signal on makes voltage input invalid.

4.2.43 Output terminal function selection (Pr. 190 to Pr. 192)

Pr. 190 "RUN terminal function selection"

Pr. 191 "FU terminal function selection"

Pr. 192 "A, B, C terminal function selection"

You can change the functions of the open collector and contact output terminals.

Parameter Number	Terminal Symbol	Factory Setting	Factory-Set Terminal Function	Setting Range
190	RUN	0	Inverter running	0 to 99
191	FU	4	Output frequency detection	0 to 99
192	ABC	99	Alarm output	0 to 99

<Setting>

Refer to the following table and set the parameters:

Setting	Signal Name	Function	Operation	Related Parameters
0	RUN	Inverter running	Output during operation when the inverter output frequency rises to or above the starting frequency.	——
1	SU	Up to frequency	Refer to Pr. 41 "up-to-frequency sensitivity". (Note 1)	Pr. 41
3	OL	Overload alarm	Output while stall prevention function is activated.	Pr. 22, Pr. 23, Pr. 66
4	FU	Output frequency detection	Refer to Pr. 42, Pr. 43 (output frequency detection).	Pr. 42, Pr. 43
11	RY	Inverter operation ready	Output when the inverter is ready to be started by switching the start signal on.	——
12	Y12	Output current detection	Refer to Pr. 150 and Pr. 151 (output current detection).	Pr. 150, Pr. 151
13	Y13	Zero current detection	Refer to Pr. 152 and Pr. 153 (zero current detection).	Pr. 152, Pr. 153
14	FDN	PID lower limit	Refer to Pr. 128 to Pr. 134 (PID control).	Pr. 128 to Pr. 134
15	FUP	PID upper limit		
16	RL	PID forward-reverse rotation output		
98	LF	Minor fault output	Output when a minor fault (fan failure or communication error warning) occurs.	Pr. 121, Pr. 244
99	ABC	Alarm output	Output when the inverter's protective function is activated to stop the output (major fault).	——

Note: 1. The same function may be set to more than one terminal.
2. Pr. 190 to Pr. 192 do not function if the values set are other than the above.

Pr. 232 to Pr. 239 ➔ Refer to Pr. 4.

Pr. 240 ➔ Refer to Pr. 72.

4.2.44 Cooling fan operation selection (Pr. 244)

Pr. 244 "cooling fan operation selection"

You can control the operation of the cooling fan built in the inverter (whether there is a cooling fan or not depends on the models. Refer to the outline dimensional drawings (page 193)).

Parameter Number	Factory Setting	Setting Range
244	0	0, 1

<Setting>

Setting	Description
0	Operated at power on (independent of whether the inverter is running or at a stop).
1	Cooling fan on-off control valid (The cooling fan is always on while the inverter is running. During a stop, the inverter status is monitored and the fan switches on-off according to temperature.)

<Reference>

In either of the following cases, fan operation is regarded as faulty, [FN] is shown on the operation panel, and the minor fault (LF) signal is output. Use any of Pr. 190 to Pr. 192 (output terminal function selection) to allocate the terminal used to output the LF signal.

1) Pr. 244 = "0"
   When the fan comes to a stop with power on.
2) Pr. 244 = "1"
   When the inverter is running and the fan stops during fan ON command.

Note: When the terminal assignment is changed using Pr. 190 to Pr. 192, the other functions may be affected. Confirm the functions of the corresponding terminals before making settings.

4.2.45 Slip compensation (Pr. 245 to Pr. 247)

Pr. 245 "rated motor slip"

Pr. 246 "slip compensation response time"

Pr. 247 "constant-output region slip compensation selection"

The inverter output current may be used to assume motor slip to keep the motor speed constant.

Parameter Number	Factory Setting	Setting Range	Remarks
245	9999	0 to 50%, 9999	9999: No slip compensation
246	0.5	0.01 to 10 s	
247	9999	0, 9999	9999: Slip compensation is made in the constant output region when Pr.245 ≠ "9999"and slip compensation is selected.

<Setting>

$$\text{Rated slip} = \frac{\text{Synchronous speed at base frequency - rated speed}}{\text{Synchronous speed at base frequency}} \times 100[\%]$$

Parameter Number	Setting	Function
245	0 to 50%	Used to set the rated motor slip.
	9999	Slip compensation is not made.
246	0.01 to 10 s	Used to set the slip compensation response time. (Note)
247	0	Slip compensation is not made in the constant output range (frequency range above the frequency set in Pr. 3).
	9999	Slip compensation is made in the constant output region when Pr.245 ≠ "9999"and slip compensation is selected. Slip compensation is not made when Pr.245 = "9999"

Note: When this value is made smaller, response will be faster.
However, as load inertia is greater, a regenerative overvoltage (OVT) error is more liable to occur.

4.2.46 Stop selection (Pr. 250)

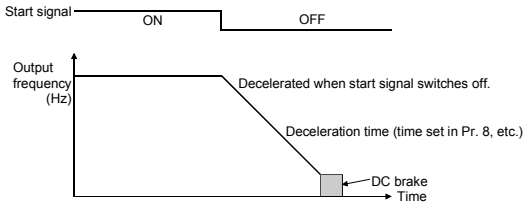
Pr. 250 "stop selection"

Related parameters
Pr. 7 "acceleration time"
Pr. 8 "deceleration time"
Pr. 44 "second acceleration/ deceleration time"
Pr. 45 "second deceleration time"

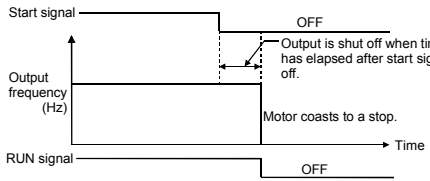
Used to select the stopping method (deceleration to a stop or coasting) when the start signal (STF/STR) switches off.

Parameter Number	Factory Setting	Setting Range
250	9999	0 to 100 s, 1000 to 1100 s, 8888, 9999

(1) Pr. 250 = "9999"
When the start signal switches off, the motor is decelerated to a stop.



(2) Pr. 250 = 0 to 100s (output is shut off after preset time)
The output is shut off when the time set in Pr. 250 has elapsed after the start signal was switched off. The motor coasts to a stop.


Start signal
OFF
Output is shut off when time set in Pr. 250 has elapsed after start signal was switched off.
Output frequency (Hz)
Motor coasts to a stop.
Time
RUN signal
OFF

When the Pr. 250 value is 8888, the functions of terminals STF and STR change as shown below:
STF = start signal, STR = rotation direction signal

STF	STR	Inverter Operating Status
OFF	OFF	Stop
OFF	ON	
ON	OFF	Forward rotation
ON	ON	Reverse rotation

When the Pr. 250 value is any of 1000 to 1100s, the functions of terminals STF and STR are the same as when the Pr. 250 value is 8888.
Also, for the stopping method used when the start signal switches off, the output is shut off (the motor coasts to a stop) after the period set in Pr. 250 (i.e. 1000s) have elapsed.

Note: 1. The RUN signal switches off when the output stops.
2. When the start signal is switched on again during motor coasting, the motor starts at 0Hz.
3. When the Pr. 250 value is 0, the output is shut off within the shortest time.

4.2.47 Output phase failure protection selection (Pr. 251)

Pr. 251 "Output phase failure protection selection"

You can make invalid the output phase failure protection (E.LF) function which stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) becomes open.
Choose "without output phase failure protection" when the motor capacity is smaller than the inverter capacity (when the output current is less than approximately 25% of the rated inverter current value as a guideline), since performing operation in such a case may activate output phase failure protection.

Parameter Number	Setting Range	Minimum Setting Increments	Factory Setting	Description
251	0, 1	1	1	0: Without output phase failure protection 1: With output phase failure protection

Pr. 254 ➔ Refer to Pr. 73

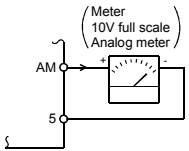
Pr. 342 ➔ Refer to Pr. 117

4.2.48 Meter (frequency meter) calibration (Pr. 901)

Pr. 901 "AM terminal calibration"

Related parameters
Pr. 55 "frequency monitoring reference"
Pr. 56 "current monitoring reference"
Pr. 158 "AM terminal function selection"

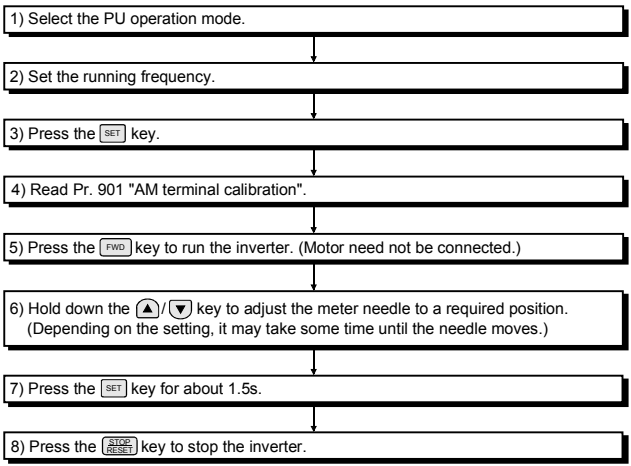
- By using the control panel or parameter unit, you can calibrate a meter connected to terminal AM to full scale deflection.
- Terminal AM is factory-set to provide a 10VDC output in the full-scale state of each monitored data. Pr. 901 allows the output voltage ratio (gain) to be adjusted according to the meter reading. Note that the maximum output voltage is 10VDC.



(1) Calibration of terminal AM
1) Connect a 0-10VDC meter (frequency meter) across inverter terminals AM-5. (Note the polarity. AM is the positive terminal.)
2) Set any of "0, 1, 2" in Pr. 158.
When the running frequency or inverter output current has been selected as the output signal, preset in Pr. 55 or Pr. 56 the running frequency or current at which the output signal is 10V.

<Operation procedure>

- When using the operation panel (FR-PA02-02)


1) Select the PU operation mode.
2) Set the running frequency.
3) Press the SET key.
4) Read Pr. 901 "AM terminal calibration".
5) Press the FWD key to run the inverter. (Motor need not be connected.)
6) Hold down the ▲/▼ key to adjust the meter needle to a required position.
(Depending on the setting, it may take some time until the needle moves.)
7) Press the SET key for about 1.5s.
8) Press the STOP RESET key to stop the inverter.

REMARKS

Calibration can also be made for external operation. Set the frequency in the external operation mode and make calibration in the steps 4) to 8).

Note: It is possible to calibrate even during operation.

4.2.49 Biases and gains of the frequency setting voltage (current) (Pr. 902 to Pr. 905)

Pr. 902 "frequency setting voltage bias"

Pr. 903 "frequency setting voltage gain"

Pr. 904 "frequency setting current bias"

Pr. 905 "frequency setting current gain"

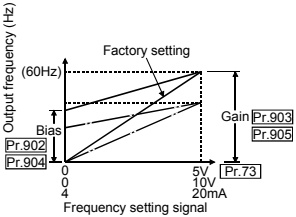
Related parameters
Pr. 38 "frequency at 5V (10V) input"
Pr. 39 "frequency at 20mA input"
Pr. 73 "0-5/0-10V selection"
Pr. 79 "operation mode selection"

The "bias" and "gain" functions are used to adjust the relationship between the input signal entered from outside the inverter (to set the output frequency), i.e. 0 to 5VDC,0 to 10VDC or 4 to 20mADC, and the output frequency.

- Use Pr. 902 to set the bias of the voltage signal and use Pr. 903 to set its gain
- Use Pr. 904 to set the bias of the current signal and use Pr. 905 to set its gain.

Parameter Number	Factory Setting (*)		Setting Range	
902	0V	0Hz	0 to 10V	0 to 60Hz
903	5V	60Hz	0 to 10V	1 to 400Hz
904	4mA	0Hz	0 to 20mA	0 to 60Hz
905	20mA	60Hz	0 to 20mA	1 to 400Hz

* Factory settings may differ because of calibration parameters.



<Setting>

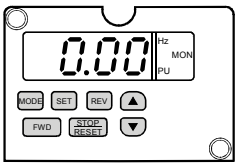
(1) The frequency setting voltage (current) biases and gains may be adjusted by any of the three following ways:
   1) Any point can be adjusted with a voltage applied across terminals 2-5 (with a current flowing across terminals 4-5).
   2) Any point can be adjusted with no voltage applied across terminals 2-5 (with no current flowing across terminals 4-5).
   3) Only the bias and gain frequencies are adjusted and the voltage (current) is not adjusted.

Pr. 903 "frequency setting voltage gain"
(Pr. 902, Pr. 904 and Pr. 905 can also be adjusted similarly.)

<Adjustment procedure>

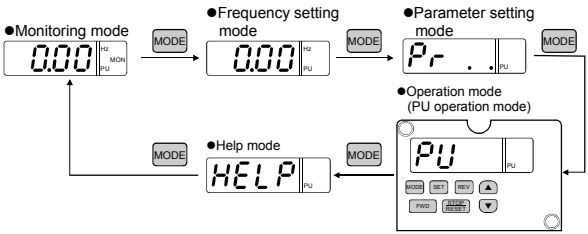
When using an external frequency setting signal to set the frequency.

(1) Power-on (monitoring mode)



(2) Choose the PU operation mode.

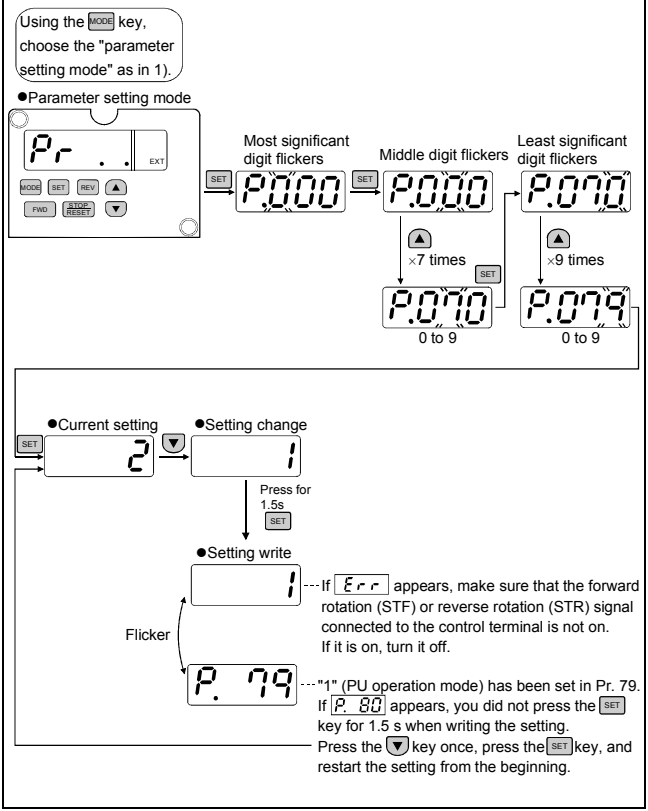
1) Using the MODE key, make sure that the PU operation mode has been selected.



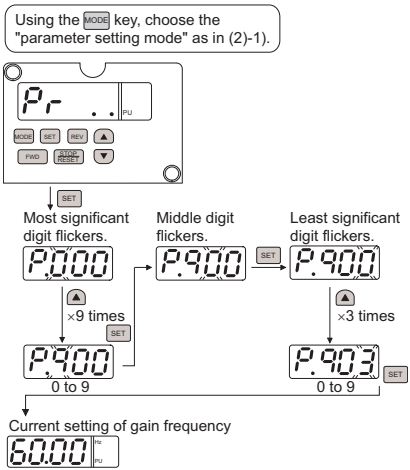
Confirm that the PU operation mode (PU) has been chosen.
In the JOG operation mode (JOG) or external operation mode (OP.Md), press the ▲/▼ key to display PU .
If PU cannot be displayed by pressing the ▲/▼ key in the external operation mode (OP.Md) (if Pr. 79 "operation mode selection" ≠ "0"), refer to 2) and set "1" (PU operation mode) in Pr. 79 "operation mode selection".

4

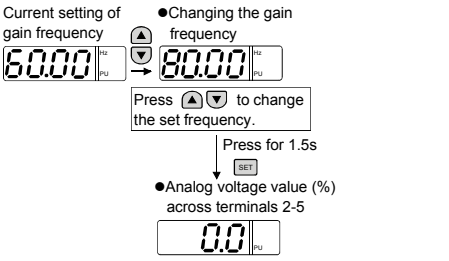
2)Set "1" (PU operation mode) in Pr. 79 "operation mode selection".
Example: To change the external operation mode (Pr. 79=2) to the PU operation mode (Pr. 79=1)


Using the MODE key, choose the "parameter setting mode" as in 1).
●Parameter setting mode
Most significant digit flickers
Middle digit flickers
Least significant digit flickers
×7 times
×9 times
0 to 9
0 to 9
●Current setting
●Setting change
Press for 1.5s
●Setting write
Flicker
If Err appears, make sure that the forward rotation (STF) or reverse rotation (STR) signal connected to the control terminal is not on. If it is on, turn it off.
"1" (PU operation mode) has been set in Pr. 79.
If P. 80 appears, you did not press the SET key for 1.5 s when writing the setting.
Press the ▼ key once, press the SET key, and restart the setting from the beginning.

(3) Read Pr. 903 and show the current setting of the gain frequency.
(Pr. 902, Pr. 904 and Pr. 905 can also be adjusted similarly.)



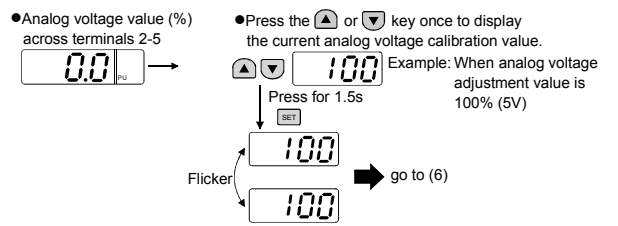
(4) Set a gain frequency in Pr. 903 and show the analog voltage value across terminals 2-5 in % (when the frequency is set to 80Hz)


Current setting of gain frequency
●Changing the gain frequency
Press ▲▼ to change the set frequency.
Press for 1.5s
SET
●Analog voltage value (%) across terminals 2-5

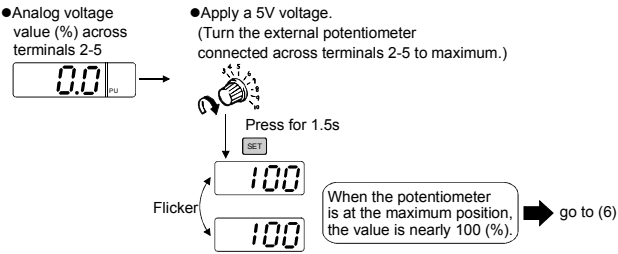
In any of the methods in (5)-1) to (5)-3) on the following page, continue the setting until the analog voltage value flickers. If you end the setting here, the gain frequency change will not be reflected.

- When not adjusting the gain voltage → go to (5)-1)
- When adjusting any point by applying a voltage → go to (5)-2)
- When adjusting any point without applying a voltage → go to (5)-3)

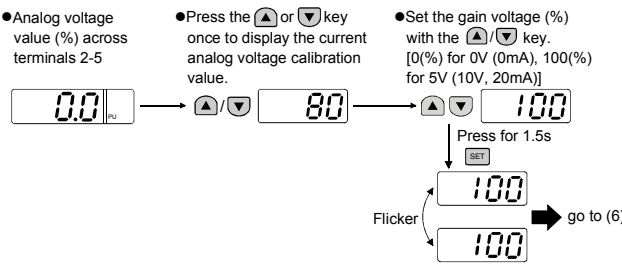
(5)-1)How to adjust only the gain frequency and not to adjust the voltage



(5)-2) How to adjust any point by applying a voltage across terminals 2-5 (e.g. from the external potentiometer) (current: across terminals 4-5) (when applying 5V))



(5)-3)How to adjust any point without applying a voltage across terminals 2-5 (without a current flowing across terminals 4-5) (when changing from 4V (80%) to 5V (100%)



(6) Press the SET key to shift to the next parameter.

(7) Re-set Pr. 79 "operation mode selection" according to the operation mode to be used.

Note: 1. If the Pr. 903 or Pr. 905 (gain adjustment) value is changed, the Pr. 20 value does not change.
2. When the Pr. 903 or Pr. 905 value is set, the value of Pr. 38 "frequency at 5V (10V) input" or Pr. 39 "frequency at 20mA input" changes automatically.

⚠ CAUTION

⚠ **Be careful when setting the bias frequency at 0V to any value other than "0". Even without the speed command, the motor will start running at the set frequency by merely switching on the start signal.**

MEMO

CHAPTER 5 PROTECTIVE FUNCTIONS

This chapter explains the "protective functions" of this product.
Always read the instructions before using the equipment.

5.1 Errors (Alarms) 164
5.2 Troubleshooting 174

5.1 Errors (Alarms)

If any fault has occurred in the inverter, the corresponding protective function is activated to bring the inverter to an alarm stop and automatically give the corresponding error (alarm) indication on the optional operation panel or the parameter unit display.
If your fault does not correspond to any of the following errors or if you have any other problem, please contact your sales representative.

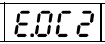
- Retention of alarm output signal ..... When the magnetic contactor (MC) provided on the power supply side of the inverter is opened at the activation of the protective function, the inverter's control power will be lost and the alarm output will not be held.
- Alarm indication ..... When the protective function is activated, the operation panel display automatically switches to the above indication.
- Resetting method..... When the protective function is activated, the inverter output is kept stopped. Unless reset, therefore, the inverter cannot restart. Switch power off once, then on again; or apply RES signal for more than 0.1s. Kept on, "Err." appears (flickers) to indicate that the inverter is being reset.
- When the protective function is activated, take the appropriate corrective action, then reset the inverter, and resume operation.

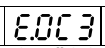
5.1.1 Error (alarm) definitions

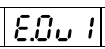
(1) Major faults

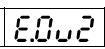
When the protective function is activated, the inverter output is shut off and the alarm is output.

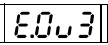
Operation Panel Indication	E. OC1		**FR-PU04-MGI**	OC During Acc
Name	Overcurrent shut-off during acceleration			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during acceleration, the protective circuit is activated to stop the inverter output			
Check point	Check for sudden acceleration. Check that the downward acceleration time is not long in vertical lift application. Check for output short-circuit/ground fault.			
Corrective action	Increase the acceleration time. (Shorten the downward acceleration time in vertical lift application.)			

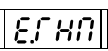
Operation Panel Indication	E. OC2		FR-PU04-MGI	Stedy Spd OC
Name	Overcurrent shut-off during constant speed			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during constant speed, the protective circuit is activated to stop the inverter output.			
Check point	Check for sudden load change. Check for output short-circuit/ground fault.			
Corrective action	Keep load stable.			

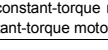
Operation Panel Indication	E. OC3		FR-PU04-MGI	OC During Dec
Name	Overcurrent shut-off during deceleration			
Description	When the inverter output current reaches or exceeds approximately 200% of the rated current during deceleration (other than acceleration or constant speed), the protective circuit is activated to stop the inverter output.			
Check point	Check for sudden speed reduction. Check for output short-circuit/ground fault. Check for too fast operation of motor's mechanical brake.			
Corrective action	Increase the deceleration time. Adjust brake operation.			

Operation Panel Indication	E. OV1		FR-PU04-MGI	OV During Acc
Name	Regenerative overvoltage shut-off during acceleration			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.			
Check point	Check for too slow acceleration. (e.g. during descending acceleration with lifting load)			
Corrective action	Decrease the acceleration time.			

Operation Panel Indication	E. OV2		FR-PU04-MGI	Stedy Spd OV
Name	Regenerative overvoltage shut-off during constant speed			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.			
Check point	Check for sudden load change.			
Corrective action	Keep load stable.			

Operation Panel Indication	E. OV3		FR-PU04-MGI	OV During Dec
Name	Regenerative overvoltage shut-off during deceleration or stop			
Description	If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. It may also be activated by a surge voltage generated in the power supply system.			
Check point	Check for sudden speed reduction.			
Corrective action	• Increase the deceleration time. (Set the deceleration time which matches the moment of inertia of the load) • Decrease the braking duty.			

Operation Panel Indication	E. THM		FR-PU04-MGI	Motor Overload
Name	Motor overload shut-off (electronic thermal relay function) (Note 1)			
Description	The electronic overcurrent protection in the inverter detects motor overheat due to overload or reduced cooling capability during constant-speed operation to stop the inverter output. When a multi-pole motor or two or more motors are run, provide a thermal relay on the output side of the inverter.			
Check point	Check the motor for use under overload.			
Corrective action	• Reduce the load weight. • For the constant-torque motor, change the Pr. 71 setting to the constant-torque motor setting.			

Operation Panel Indication	E. THT		FR-PU04-MGI	Inv. Overload
Name	Inverter overload shut-off (electronic thermal relay function) (Note 1)			
Description	If a current of more than 150% of the rated output current flows and overcurrent shut-off does not occur (200% or less), inverse-time characteristics cause the electronic thermal relay function to be activated to stop the inverter output in order to protect the output transistors.			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			

Note: 1. Resetting the inverter initializes the internal heat integrating data of the electronic thermal relay function.

Operation Panel Indication	E. FIN	E.FIn	FR-PU04-MGI	H/Sink O/Temp
Name	Fin overheat			
Description	If the heatsink overheats, the temperature sensor is actuated to stop the inverter output.			
Check point	• Check for too high ambient temperature. • Check for heatsink clogging.			
Corrective action	Set the ambient temperature to within the specifications.			

Operation Panel Indication	E. BE	E. bE	FR-PU04-MGI	Br. Cct. Fault (Note)
Name	Brake transistor alarm detection			
Description	If a brake transistor fault occurs due to excessively large regenerative energy from the motor, for example, that fault is detected to stop the inverter output. In this case, the inverter power must be switched off immediately.			
Check point	Check for improper braking duty.			
Corrective action	Change the inverter. Please contact your sales representative.			

Operation Panel Indication	E. GF	E. GF	FR-PU04-MGI	Ground Fault
Name	Output side ground fault overcurrent protection			
Description	This function stops the inverter output if a ground fault overcurrent flows due to a ground fault which occurred in the inverter's output (load) side.			
Check point	Check for a ground fault in the motor and connection cable.			
Corrective action	Remedy the ground fault portion.			

Operation Panel Indication	E. OHT	E.OHT	FR-PU04-MGI	OH Fault
Name	External thermal relay operation (Note 2)			
Description	If the external thermal relay provided for motor overheat protection or the internally mounted temperature relay in the motor switches on (contacts open), the inverter output is stopped. If the relay contacts are reset automatically, the inverter will not restart unless it is reset.			
Check point	•Check for motor overheating. •Check that the value of "7" (OH signal) is set correctly in any of Pr. 180 to Pr. 183 (input terminal function selection).			
Corrective action	Reduce the load and operating duty.			

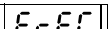
Note: 2. This function is activated only when OH has been set to any of Pr. 180 to Pr. 183 (input terminal function selection).

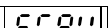
Operation Panel Indication	E. OLT		FR-PU04-MGI	Stll Prev STP
Name	Stall prevention			
Description	The running frequency has fallen to 0 by stall prevention activated. (OL while stall prevention is being activated.)			
Check point	Check the motor for use under overload.			
Corrective action	Reduce the load weight.			

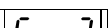
Operation Panel Indication	E.OPT		FR-PU04-MGI	Option Fault
Name	Option alarm			
Description	Stops the inverter output if a functional fault (e.g. communication error of the communication option) occurs in the communication option. Stops the inverter output if the inverter station is disconnected from the system in the NET mode. Stops the inverter output if a setting error or connection (connector) fault occurs during use of in-board option.			
Check point	Check that the communication cable is not open.			
Corrective action	Please contact your sales representative.			

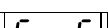
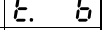
Operation Panel Indication	E. PE		FR-PU04-MGI	Corrupt Memory
Name	Parameter storage device alarm			
Description	A fault occurred in parameters stored (example: E^2PROM fault).			
Check point	Check for too many number of parameter write times.			
Corrective action	Please contact your sales representative.			

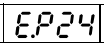
Operation Panel Indication	E. PUE		FR-PU04-MGI	PU Leave Out
Name	Parameter unit disconnection			
Description	This function stops the inverter output if communication between the inverter and PU is suspended, e.g. the PU is disconnected, when "2", "3", "16" or "17" was set in Pr. 75. This function stops the inverter output if the number of successive communication errors is greater than the number of permissible retries when the Pr. 121 value is other than "9999" for RS-485 communication from the PU connector.			
Check point	• Check for loose fitting of the operation panel (FR-PA02-02) or FR-PU04-MGI. • Check the Pr. 75 setting.			
Corrective action	Fit the operation panel (FR-PA02-02) and FR-PU04-MGI securely.			

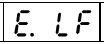
Operation Panel Indication	E. RET		FR-PU04-MGI	Retry No Over
Name	Retry count exceeded			
Description	If operation cannot be resumed properly within the number of retries set, this function stops the inverter output.			
Check point	Find the cause of alarm occurrence.			
Corrective action	Eliminate the cause of the error preceding this error indication.			

Operation Panel Indication	E. CPU		FR-PU04-MGI	CPU Fault
Name	CPU error			
Description	If the arithmetic operation of the built-in CPU does not end within a predetermined period, the inverter self-determines it as an alarm and stops the output.			
Check point	———			
Corrective action	Please contact your sales representative.			

Operation Panel Indication	E. 3		FR-PU04-MGI	Fault 3
Name	Option fault			
Description	Also stops the inverter output if the dedicated option used in the inverter results in setting error or connection (connector) fault.			
Check point	• Check that the function setting and operation of the option are correct. • Check that the communication option is plugged in the connector securely. • Check for devices producing excess electrical noises around the inverter.			
Corrective action	• Connect the communication option securely. • Take measures against noises if there are devices producing excess electrical noises around the inverter. • Contact your sales representative.			

Operation Panel Indication	E. 6		FR-PU04-MGI	Fault 6
	E. 7			Fault 7
Name	CPU error			
Description	This function stops the inverter output if a communication error occurs in the built-in CPU.			
Check point	Check for devices producing excess electrical noises around the inverter.			
Corrective action	• Take measures against noises if there are devices producing excess electrical noises around the inverter. • Please contact your sales representative.			

Operation Panel Indication	E. P24		FR-PU04-MGI	Pr.24 alarm
Name	24VDC power output short circuit			
Description	When the 24VDC power output from the PC terminal is shorted, this function shuts off the power output. At this time, all external contact inputs switch off. The inverter cannot be reset by entering the RES signal. To reset it, use the operation panel or switch power off, then on again.			
Check point	Check for a short circuit in the PC terminal output.			
Corrective action	Remedy the ground fault portion.			

Operation Panel Indication	E. LF		FR-PU04-MGI	E. LF
Name	Output phase failure protection			
Description	This function stops the inverter output if one of the three phases (U, V, W) on the inverter's output side (load side) results in open phase.			
Check point	• Check the wiring (Check the motor for a fault.) • Check that the capacity of the used motor is not smaller than the inverter capacity.			
Corrective action	• Wire the cables properly. • Check the setting of Pr. 251 "output phase failure protection selection".			

(2) Minor fault

The output is not shut off when the protective function is activated. You can make parameter setting to output the minor fault signal. (Set "98" in any of Pr. 190 to Pr. 192 (output terminal function selection). Refer to page 149.)

Operation Panel Indication	FN		FR-PU04-MGI	Fan Failure
Name	Fan fault			
Description	For the inverter which contains a cooling fan, FN appears on the operation panel when the cooling fan stops due to a fault or operates differently from the setting of Pr. 244 "cooling fan operation selection"			
Check point	Check the cooling fan for a fault.			
Corrective action	Replace the fan. (Refer to page 183.)			

(3) Warnings

Operation Panel Indication	OL		FR-PU04-MGI	OL
Name	Stall prevention (overcurrent)			
Description	During acceleration	If a current of more than 150% (Note 5) of the rated inverter current flows in the motor, this function stops the increase in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency again.		
	During constant-speed operation	If a current of more than 150% (Note 5) of the rated inverter current flows in the motor, this function lowers the frequency until the overload current reduces to prevent overcurrent shut-off. When the overload current has reduced below 150%, this function increases the frequency up to the set value.		
	During deceleration	If a current of more than 150% (Note 5) of the rated inverter current flows in the motor, this function stops the decrease in frequency until the overload current reduces to prevent the inverter from resulting in overcurrent shut-off. When the overload current has reduced below 150%, this function decreases the frequency again.		
Check point	Check the motor for use under overload.			
Corrective action	The acceleration/deceleration time may change. Increase the stall prevention operation level with Pr. 22 "stall prevention operation level", or disable stall prevention with Pr. 156 "stall prevention operation selection".			

Note:5. The stall prevention operation current can be set as desired. It is factory-set to 150%.

Operation Panel Indication	oL		FR-PU04-MGI	oL
Name	Stall prevention (overvoltage)			
Description	During deceleration	If the regenerative energy of the motor increases too much to exceed the brake capability, this function stops the decrease in frequency to prevent overvoltage shut-off. As soon as the regenerative energy has reduced, deceleration resumes.		
Check point	Check for sudden speed reduction.			
Corrective action	The deceleration time may change. Increase the deceleration time using Pr. 8 "deceleration time".			

Operation Panel Indication	PS		FR-PU04-MGI	PS
Name	PU stop			
Description	A stop made by pressing the STOP RESET key of the PU has been set in Pr. 75 "PU stop selection".			
Check point	Check for a stop made by pressing the STOP RESET key of the operation panel during external operation.			
Corrective action	Refer to page 108.			

Operation Panel Indication	Err.	
Description	This alarm appears if: • The RES signal is on; • You attempted to set any parameter value in the external operation mode; • You attempted to change the operation mode during operation; • You attempted to set any parameter value outside its setting range. • You attempted to set any parameter value during operation (while signal STF or STR is ON). • You attempted to set any parameter value while parameter write is being inhibited in Pr. 77 "parameter write disable selection".	
Corrective action	Perform operation correctly.	

5.1.2 To know the operating status at the occurrence of alarm

When any alarm has occurred, the display automatically switches to the indication of the corresponding protective function (error). By pressing the MODE key at this point without resetting the inverter, the display shows the output frequency. In this way, it is possible to know the running frequency at the occurrence of the alarm. This also applies to the current. After resetting, you can confirm the data in the alarm history (refer to page 54).

5.1.3 Correspondence between digital and actual characters

There are the following correspondences between the actual alphanumeric characters and the digital characters displayed on the operation panel (FR-PA02-02):

Actual	Display
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

Actual	Display
A	
B	
C	
D	
E	
F	
G	
H	
I	
J	
L	

Actual	Display
M	
N	
O	
o	
P	
S	
T	
U	
V	
r	
-	

5.1.4 Resetting the inverter

The inverter can be reset by performing any of the following operations. Note that the electronic overcurrent protection's internal heat calculation value and the number of retries are cleared (erased) by resetting the inverter.
Recover about 1s after reset is cancelled.

Operation 1: .....Using the operation panel (FR-PA02-02), press the STOP/RESET key to reset the inverter. (This may only be performed when the inverter protective function (major fault) is activated.)
Operation 2: .....Switch power off once, then switch it on again.
Operation 3: .....Switch on the reset signal (RES).

5.2 Troubleshooting

POINT: Check the corresponding areas. If the cause is still unknown, it is recommended to initialize the parameters (return to factory settings), re-set the required parameter values, and check again.

5.2.1 Motor remains stopped

1) Check the main circuit
- Check that a proper power supply voltage is applied (operation panel display is provided).
- Check that the motor is connected properly.
- Check that the conductor across P1-P (+) is connected.

2) Check the input signals
- Check that the start signal is input.
- Check that both the forward and reverse rotation start signals are not input.
- Check that the frequency setting signal is not zero.
- Check that the AU signal is on when the frequency setting signal is 4 to 20mA.
- Check that the output stop signal (MRS) or reset signal (RES) is not on.
- Check that the sink/source jumper connector is fitted securely.

3) Check the parameter settings
- Check that the reverse rotation prevention (Pr. 78) is not selected.
- Check that the operation mode (Pr. 79) setting is correct.
- Check that the bias and gain (Pr. 902 to Pr. 905) settings are correct.
- Check that the starting frequency (Pr. 13) setting is not greater than the running frequency.
- Check that various operational functions (such as three-speed operation), especially the maximum frequency (Pr. 1), are not zero.
- Check that the manufacturer setting parameter Pr. 146 = 1.

4) Check the load
- Check that the load is not too heavy.
- Check that the shaft is not locked.

5) Others
- Check that the ALARM lamp is off.
- Check that the operation panel display does not show an error (e.g. E.OC1).
- Check that the Pr. 15 "jog frequency" setting is not lower than the Pr. 13 "starting frequency" value.

5.2.2 Motor rotates in opposite direction

- Check that the phase sequence of output terminals U, V and W is correct.
- Check that the start signals (forward rotation, reverse rotation) are connected properly.

5.2.3 Speed greatly differs from the setting

- Check that the frequency setting signal is correct. (Measure the input signal level.)
- Check that the following parameter settings are correct (Pr. 1, Pr. 2, Pr. 19, Pr. 38, Pr. 39, Pr. 245, Pr. 902 to Pr. 905).
- Check that the input signal lines are not affected by external noise. (Use shielded cables)
- Check that the load is not too heavy.

5.2.4 Acceleration/deceleration is not smooth

- Check that the acceleration and deceleration time settings are not too short.
- Check that the load is not too heavy.
- Check that the torque boost setting is not too large to activate the stall prevention function.

5.2.5 Motor current is large

- Check that the load is not too heavy.
- Check that the torque boost setting is not too large.

5.2.6 Speed does not increase

- Check that the maximum frequency setting is correct.
- Check that the load is not too heavy. (In agitators, etc., load may become heavier in winter.)
- Check that the torque boost setting is not too large to activate the stall prevention function.
- Check that the brake resistor is not connected to terminals P (+) -P1 or terminals P1-PR accidentally.

5.2.7 Speed varies during operation

When slip compensation is selected, the output frequency varies with load fluctuation between 0 and 2Hz. This is a normal operation and is not a fault.

1) Inspection of load

- Check that the load is not varying.

2) Inspection of input signal

- Check that the frequency setting signal is not varying.
- Check that the frequency setting signal is not affected by noise.
- Check that a malfunction does not occur due to an undesirable current when the transistor output unit is connected, for example. (Refer to page 25.)

3) Others

- Check that the setting of the applied motor capacity (Pr. 80) is correct for the inverter capacities in general-purpose magnetic flux vector control.
- Check that the wiring length is within 30m (98.42 feet) in general-purpose magnetic flux vector control.
- Check that the wiring length is correct in V/F control.

5.2.8 Operation mode is not changed properly

If the operation mode does not change correctly, check the following:

1) External input signal ..... Check that the STF or STR signal is off. When it is on, the operation mode cannot be changed.

2) Parameter setting ..... Check the Pr. 79 setting. When the setting of Pr. 79 "operation mode selection" is "0", switching input power on places the inverter in the external operation mode. By pressing the MODE key twice and pressing the ▲ key, the external operation mode changes to the PU operation mode. For any other setting (1 to 8), the operation mode is limited according to the setting.
(For details of Pr. 79, refer to page 111.)

5.2.9 Operation panel display is not operating

- Make sure that the operation panel is connected securely with the inverter.
- Check for a short circuit across terminals PC-SD.
- Check that the jumper across terminals P (+) -P1 is fitted securely.

5.2.10 POWER lamp is not lit

- Make sure that the wiring and installation are correct.

5.2.11 Parameter write cannot be performed

- Make sure that operation is not being performed (signal STF or STR is not ON).
- Make sure that you pressed the SET key (WRITE key) for longer than 1.5 s.
- Make sure that you are not attempting to set the parameter outside the setting range.
- Make sure that you are not attempting to set the parameter in the external operation mode.
  (Set "2" in Pr. 77 when performing parameter setting in the external operation mode. (Refer to page 110))
- Check Pr. 77 "parameter write disable selection".

CHAPTER6 MAINTENANCE/ INSPECTION

This chapter explains the "maintenance/inspection" of this product.
Always read the instructions before using the equipment.

6.1 Precautions for Maintenance and Inspection 178

6.1 Precautions for Maintenance and Inspection

The transistorized inverter is a static unit mainly consisting of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to adverse influence by the operating environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

6.1.1 Precautions for maintenance and inspection

For some short time after the power is switched off, a high voltage remains in the smoothing capacitor. Therefore, when more than 10 minutes have elapsed after power-off, make sure that the voltage across the main circuit terminals P (+) - N (–) of the inverter is 30VDC or less using a meter, etc. Then, access the inverter for inspection.

6.1.2 Check items

(1) Daily inspection

- Check the following:
  1) Motor operation fault
  2) Improper installation environment
  3) Cooling system fault
  4) Unusual vibration and noise
  5) Unusual overheating and discoloration
- During operation, check the inverter input voltages using a meter.

(2) Cleaning

Always run the inverter in a clean state.

When cleaning the inverter, gently wipe dirty areas with a soft cloth immersed in neutral detergent or ethanol.

Note: Do not use solvent, such as acetone, benzene, toluene and alcohol, as they will cause the inverter surface paint to peel off.
Do not use detergent or alcohol to clean the display and other sections of the operation panel as these sections may deform.

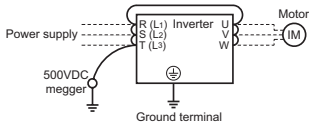
6.1.3 Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.

1) Cooling system: ..... Clean the air filter, etc.
2) Screws and bolts: ..... These parts may become loose due to vibration, temperature changes, etc. Check that they are tightened securely and retighten as necessary.
3) Conductors and insulating materials: Check for corrosion and damage.
4) Insulation resistance: Measure.
5) Cooling fan, smoothing capacitor: Check and change if necessary.

6.1.4 Insulation resistance test using megger

1) Before performing the insulation resistance test using a megger on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
2) For the continuity test of the control circuit, use a meter (high resistance range) and do not use the megger or buzzer.
3) For the inverter, conduct the insulation resistance test on the main circuit only as shown below and do not perform the test on the control circuit. (Use a 500VDC megger.)



6.1.5 Pressure test

Do not conduct a pressure test. The inverter's main circuit uses semiconductors, which may deteriorate if a pressure test is made.

6.1.6 Daily and periodic inspection

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer's check
			Daily	Periodic* 1 year	Periodic* 2 years				
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	O			Refer to page 14.	Ambient temperature: -10°C to +40°C (14°F to 104°F), non-freezing. Ambient humidity: 90% or less, non-condensing.	Thermo-meter, hygrometer, recorder	
	Overall unit	Check for unusual vibration and noise.	O			Visual and auditory checks.	No fault.		
	Power supply voltage	Check that main circuit voltage is normal.	O			Measure voltage across inverter terminals R-S-T (L_1-L_2-L_3).	Within permissible AC (DC) voltage fluctuation (Refer to page 190)	Meter, digital multimeter	
Main circuit	General	(1) Check with megger (across main circuit terminals and ground terminal). (2) Check for loose screws and bolts. (3) Check for overheat on each part. (4) Clean.		O O O	O	(1) Disconnect all cables from inverter and measure across terminals R (L_1), S (L_2), T (L_3), U, V, W and ground terminal with megger. (2) Retighten. (3) Visual check.	(1) 5MΩ or more. (2), (3) No fault.	500VDC class megger	
	Conductors, cables	(1) Check conductors for distortion. (2) Check cable sheaths for breakage.		O O		(1), (2) Visual check.	(1), (2) No fault.		
	Terminal block	Check for damage.		O		Visual check	No fault		
	Inverter module Converter module	Check resistance across terminals.			O	Disconnect cables from inverter and measure across terminals R, S, T-P, N (L_1, L_2, L_3 - +, –), and across U, V, W - P (+), N (–) with a meter with a 100Ω range.	Refer to page 182.	Analog meter	
	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulge. (3) Measure electrostatic capacity.	O O	 O		(1), (2) Visual check. (3) Measure with capacity meter.	(1), (2) No fault. (3) 85% or more of rated capacity.	Capacity meter	

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument	Customer's check
			Daily	Periodic* 1 year	Periodic* 2 years				
Main circuit	Relay	(1) Check for chatter during operation. (2) Check for rough surface on contacts.		O O		(1) Auditory check. (2) Visual check.	(1) No fault. (2) No fault.		
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently. (2) Perform sequence protective operation test to make sure there is no fault in protective or display circuits.		O O		(1) Measure voltage across inverter output terminals U-V-W. (2) Simulate connection of inverter protective circuit output terminals.	(1) Phase-to-phase voltage balance within 12V. (2) Fault must occur because of sequence.	Digital multimeter, rectifier type voltmeter	
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose connection.	O	 O		(1) Turn by hand with power off. (2) Visual check.	No unusual vibration and unusual noise.		
Display	Display	(1) Check for LED lamp blown. (2) Clean.	O	 O		(1) Lamps indicate indicator lamps on panel. (2) Clean with rag.	(1) Check that lamps are lit.		
	Meter	Check that reading is normal.	O			Check reading of meters on panel.	Must satisfy specified and management values.	Voltmeter, ammeter, etc.	
Motor	General	(1) Check for unusual vibration and noise. (2) Check for unusual odor.	O O			(1) Auditory, sensory, visual checks. (2) Check for unusual odor due to overheat, damage, etc.	(1), (2) No fault.		
	Insulation resistance	Check with megger (across terminals and ground terminal).			O	Disconnect cables from U, V, W, including motor cables.	5MΩ or more.	500V megger	

6

● **Checking the inverter and converter modules**

<Preparation>

(1) Disconnect the external power supply cables (R, S, T (L_1, L_2, L_3)) and motor cables (U, V, W).

(2) Prepare a meter. (Use 100Ω range.)

<Checking method>

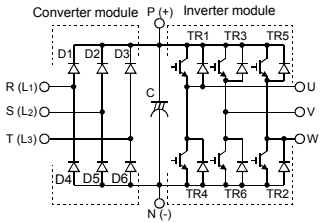
Change the polarity of the meter alternately at the inverter terminals R (L_1), S (L_2), T (L_3), U, V, W, P (+) and N (–), and check for continuity.

Note: 1. Before measurement, check that the smoothing capacitor is discharged.
2. At the time of discontinuity, the measured value is almost ∞. When there is an instantaneous continuity, due to the smoothing capacitor the tester may not indicate ∞. At the time of continuity, the measured value is several to several ten's-of ohms depending on the number of modules, number of parallel modules, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

<Module device numbers and terminals to be checked>

		Tester Polarity		Measured Value		Tester Polarity		Measured Value
		⊕	⊖			⊕	⊖	
Converter module	D1	R (L_1)	P (+)	Discontinuity	D4	R (L_1)	N (–)	Continuity
		P (+)	R (L_1)	Continuity		N (–)	R (L_1)	Discontinuity
	D2	S (L_2)	P (+)	Discontinuity	D5	S (L_2)	N (–)	Continuity
		P (+)	S (L_2)	Continuity		N (–)	S (L_2)	Discontinuity
	D3	T (L_3)	P (+)	Discontinuity	D6	T (L_3)	N (–)	Continuity
		P (+)	T (L_3)	Continuity		N (–)	T (L_3)	Discontinuity
Inverter module	TR1	U	P (+)	Discontinuity	TR4	U	N (–)	Continuity
		P (+)	U	Continuity		N (–)	U	Discontinuity
	TR3	V	P (+)	Discontinuity	TR6	V	N (–)	Continuity
		P (+)	V	Continuity		N (–)	V	Discontinuity
	TR5	W	P (+)	Discontinuity	TR2	W	N (–)	Continuity
		P (+)	W	Continuity		N (–)	W	Discontinuity

(Assumes the use of an analog meter.)



6.1.7 Replacement of parts

The inverter consists of many electronic parts such as semiconductor devices.
The following parts may deteriorate with age because of their structural or physical characteristics, leading to reduced performance or failure of the inverter. For preventive maintenance, the parts must be changed periodically.

Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Replace (as required)
Smoothing capacitor in main circuit	8 years *	Replace (as required)
Smoothing capacitor on control board	8 years *	Replace the board (as required).

* The design life of electrolytic capacitor is about eight years (50000h) if used for 20 hours a day and 300 days a year in the average yearly ambient temperature of 35°C.

Note: For part replacement, contact the nearest MGI office.

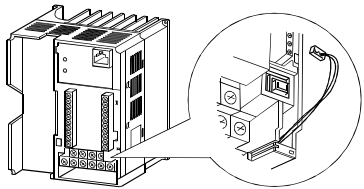
(1) Cooling fan

The cooling fan cools heat-generating parts such as the main circuit semiconductor devices. The life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be changed every 2 to 3 years if the inverter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be replaced immediately.

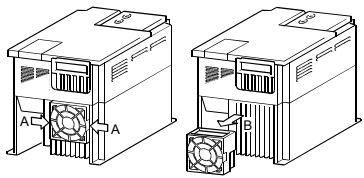
Inverter Model No.	Fan Type
M4500E-002, 003	MMF-06D24ES-FC4 BKO-CA1027H09
M4500E-005, 007.5, 010	MMF-06D24ES-FC5 BKO-CA1027H10

● **Removal**

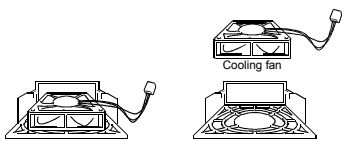
1) Remove the front cover (Refer to page 6).
2) Unplug the fan connector.
   The cooling fan is connected to the cooling fan connector beside the main circuit terminal block of the inverter.
   Unplug the connector.



3) Remove the inverter and cooling fan.
   Push in the direction of arrow A and pull out in the direction of arrow B.

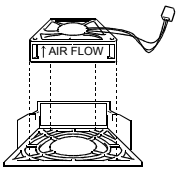


4) Remove the cooling fan and cooing fan cover.
   The cooling fan is secured by the fixing hooks.
   You can remove the cooling fan and cooling fan cover by disengaging the fixing hooks.

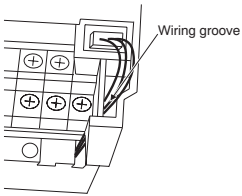


● **Reinstallation**

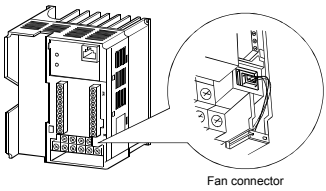
1) After confirming the orientation of the fan, reinstall the fan to the cover so that the arrow on the left of "AIR FLOW" faces in the opposite direction of the fan cover.
   Note: If the air flow is set in the wrong direction, the inverter life can be shorter.



2) Reinstall the fan cover to the inverter.
   Run the cable through the wiring groove to prevent it from being caught between the chassis and cover.



3) Reconnect the cable to the connector.



4) Reinstall the front cover.

(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing the DC in the main circuit, and an aluminum electrolytic capacitor is also used for stabilizing the control power in the control circuit.
Their characteristics are adversely affected by ripple current, etc. When the inverter is operated in an ordinary, air-conditioned environment, change the capacitors about every 5 years. When 5 years have elapsed, the capacitors will deteriorate more rapidly. Check the capacitors at least every year (less than six months if the life will be expired soon). Check the following:

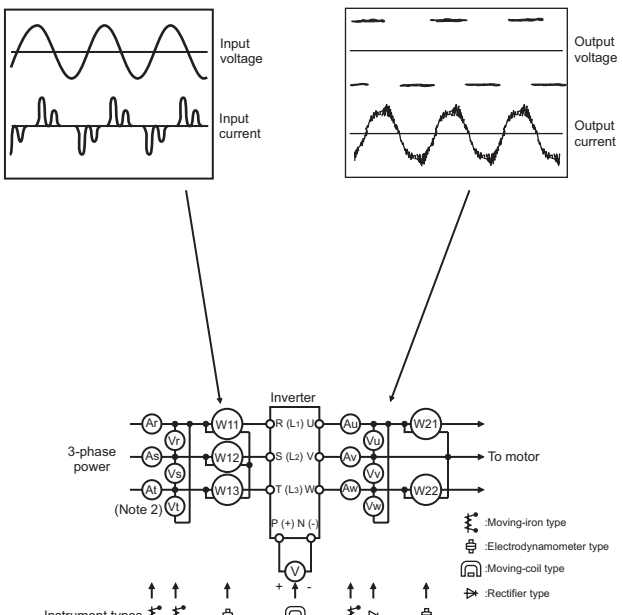
1) Case (side faces and bottom face for expansion)
2) Sealing plate (for remarkable warp and extreme crack)
3) Appearance, external cracks, discoloration, leakage.
   When the measured capacitance of the capacitor has reduced below 80% of the rating, replace the capacitor.

6.1.8 Measurement of main circuit voltages, currents and powers

● **Measurement of voltages and currents**

Since the voltages and currents on the inverter power supply and output sides include harmonics, accurate measurement depends on the instruments used and circuits measured.

When instruments for commercial frequency are used for measurement, measure the following circuits using the instruments given on the next page.



Typical Measuring Points and Instruments

Note: Use FFT (Fast Fourier Transforms) to measure the output voltage accurately. It cannot be measured accurately with a meter or general instrument.

Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value)	
Power supply voltage (V1)	Across R-S (L_1-L_2), S-T (L_2-L_3) and T-R (L_3-L_1)	Moving-iron type AC voltmeter	Is the commercial power supply within permissible variation of AC voltage (Refer to page 190)	
Power supply side current (I1)	R, S and T line currents (L_1, L_2 and L_3 line currents)	Moving-iron type AC ammeter		
Power supply side power (P1)	At R (L_1), S (L_2) and T (L_3), and across R-S (L_1-L_2), S-T (L_2-L_3) and T-R (L_3-L_1)	Electrodynamic type single-phase wattmeter	P1 = W11 + W12 + W13 (3-wattmeter method)	
Power supply side power factor (Pf1)	Calculate after measuring power supply voltage, power supply side current and power supply side power. [For three-phase power supply] $Pf1=\frac{P1}{\sqrt{3}V\times I1}\times 100\%$			
Output side voltage (V2)	Across U-V, V-W and W-U	(Note 1) (Cannot be measured by moving-iron type)	Difference between phases is within ±1% of maximum output voltage.	
Output side current (I2)	U, V and W line currents	Moving-iron type AC ammeter (Note 2)	Current should be equal to or less than rated inverter current.Difference between phases is 10% or lower.	
Output side power (P2)	At U, V and W, and across U-V and V-W	Electrodynamic type single-phase wattmeter	P2 = W21 + W22 2-wattmeter method (or 3-wattmeter method)	
Output side power factor (Pf2)	Calculate in similar manner to power supply side power factor. $Pf2=\frac{P2}{\sqrt{3}V2\times I2}\times 100\%$			
Converter output	Across P-N (+ - –)	Moving-coil type (such as tester)	Inverter LED display is lit. 1.35 × V1 Maximum 923V during regenerative operation	
Frequency setting signal	Across 2 (positive)-5	Moving-coil type (Meter, etc. may be used) (Internal resistance: 50Ω or larger)	0 to 5V/0 to 10VDC	"5" is common.
	Across 4 (positive)-5		4 to 20mADC	
Frequency setting power supply	Across 10 (positive)-5		5VDC	
Frequency meter signal	Across AM (+)-5		Approximately 10DVC at maximum frequency (without frequency meter)	
Start signal Select signal	Across STF, STR, RH, RM, RL, MRS, RES-SD	Moving-coil type (Meter, etc. may be used) (Internal resistance: 50kΩ or larger)	20 to 30VDC when open.ON voltage: 1V or less	SD is common.
Reset	Across RES (positive)-SD			
Output stop	Across MRS (positive)-SD			
Alarm signal	Across A-C Across B-C	Moving-coil type (such as a meter)	Continuity check <Normal> <Fault> Across A-C: Discontinuity Continuity Across B-C: Continuity Discontinuity	

Note: 1. Use FFT to measure the output voltage accurately. It can not be measured accurately with a meter or general instrumentation.
2. If the carrier frequency exceeds 5kHz, do not use this instrument since using it may increase eddy-current loss produced in metal parts inside the instrument, leading to burnout.
In this case, use an approximate effective value type instrument.

MEMO

CHAPTER7 SPECIFICATIONS

This chapter explains the "protective functions" of this product.
Always read the instructions before using the equipment.

7.1 Standard Specifications 190

7.1 Standard Specifications

7.1.1 Model specifications

3-phase 575V power supply

Type M4500E-□□□			001	002	003	005	007.5	010
Applicable motor capacity (Note 1)		kW	0.75	1.5	2.2	3.7	5.5	7.5
		HP	1	2	3	5	7.5	10
Output	Rated capacity (kVA) (Note 2)		1.7	2.7	4.0	6.1	9.0	12.0
	Rated current (A)		1.7	2.7	4.0	6.1	9.0	12.0
	Overload capacity (Note 3)		150% 60s 200% 0.5s (inverse-time characteristics)					
	Voltage (Note 4)		Three phase, 575V 60Hz					
Power supply	Rated input AC voltage, frequency		Three phase, 575V 60Hz					
	Permissible AC voltage fluctuation		490V to 632V 60Hz					
	Permissible frequency fluctuation		±5%					
	Power supply system capacity (kVA) (Note 5)		2.5	4.5	5.5	9.0	12.0	17.0
Protective structure (JEM1030)			Enclosed type (IP20)					
Cooling system			Self-cooling	Forced air cooling				
Approximate weight (kg (lbs))			1.8 (3.96)	2.0 (4.41)	2.0 (4.41)	3.8 (8.38)	3.8 (8.38)	3.8 (8.38)

Note: 1. The applicable motor capacity indicated is the maximum capacity applicable when a 4-pole standard motor is used.
2. The rated output capacity indicated assumes that the output voltage is 575V.
3. The overload capacity indicated in % is the ratio of the overload current to the inverter's rated current. For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
4. The maximum output voltage does not exceed the power supply voltage. The maximum output voltage can be changed within the setting range. However, the pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
5. The power supply capacity changes with the values of the power supply side inverter impedances (including those of the input reactor and cables).

7.1.2 Common specifications

Control specifications	Control system			Soft-PWM control/high carrier frequency PWM control can be selected. V/F control or general-purpose magnetic flux vector control can be selected.
	Output frequency range			0.2 to 400Hz (starting frequency variable between 0 and 60Hz)
	Frequency setting resolution		Analog input	Across terminals 2-5: 1/500 of maximum set frequency (5VDC input), 1/1000 (10VDC, 4-20mADC input)
			Digital input	0.01Hz (less than 100Hz), 0.1Hz (100Hz or more) when digital setting is made using the operation panel
	Frequency accuracy		Analog input	Within ±0.5% of maximum output frequency (25°C ±10°C (77°F ± 18°F))
			Digital input	Within 0.01% of set output frequency when setting is made from operation panel.
	Voltage/frequency characteristic			Base frequency set as required between 0 and 400Hz. Constant torque or variable torque pattern can be selected.
	Torque boost			Manual torque boost, 0 to 30% may be set.
	Acceleration/deceleration time setting			0.01, 0.1 to 3600 s (acceleration and deceleration can be set individually), linear or S-pattern acceleration/deceleration mode can be selected.
	Braking torque		Regenerative (Note 3)	001 ... 100%, 002 ... 50%, 003, 005, 007.5, 010 ... 20%
			DC injection brake	Operation frequency (0 to 120Hz), operation time (0 to 10 s), operation voltage (0 to 30%) variable
	Current stall prevention operation level			Operation current level can be set (0 to 200% variable), presence or absence can be selected.
	Voltage stall prevention operation level			Operation level is fixed, presence or absence can be selected.
	High-response current limit level			Operation level is fixed, presence or absence can be selected.
	Input signals	Frequency setting signal	Analog input	0 to 5VDC, 0 to 10VDC, 4 to 20mADC
			Digital input	Entered from operation panel (optional FR-PA02-02).
		Start signal		Forward rotation and reverse rotation, start signal self-holding input (3-wire input) selectable.
		Alarm reset		Used to reset alarm output provided when protective function is activated.
		Multi-speed selection		Up to 15 speeds can be selected. (Each speed can be set between 0 and 400Hz, running speed can be changed during operation from the operation panel.)
		Second function selection		Used to select second functions (acceleration time, deceleration time, torque boost, base frequency, electronic overcurrent protection).
		Output stop		Instantaneous shut-off of inverter output (frequency, voltage).
		Current input selection		Used to select input of frequency setting signal 4 to 20mADC (terminal 4).
		External thermal relay input		Thermal relay contact input for use when the inverter is stopped by the external thermal relay.
		PU operation-external operation switchover		Used to switch between PU operation and external operation from outside the inverter.
		V/F-general-purpose magnetic flux switching		Used to switch between V/F control and general-purpose magnetic flux vector control from outside the inverter.

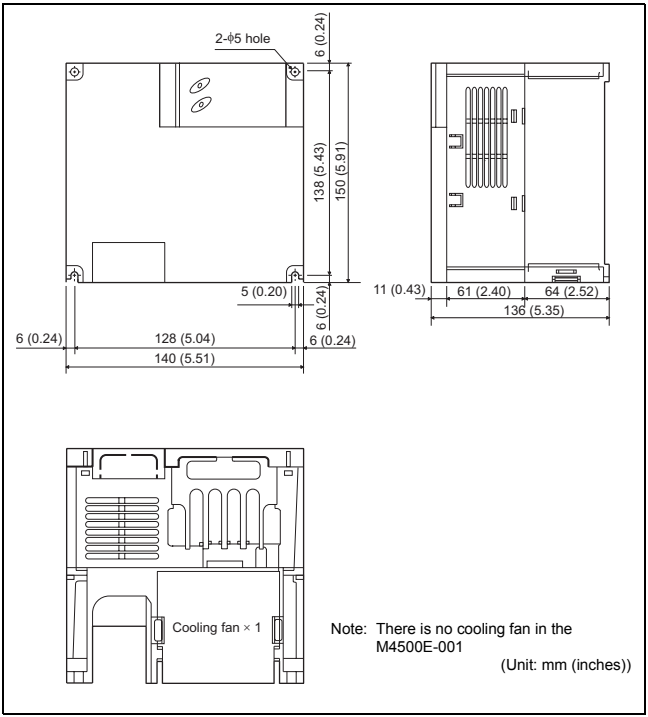
Use Pr. 180 to Pr. 183 for selection.

Control specifications	Operation functions			Maximum/minimum frequency setting, frequency jump operation, external thermal relay input selection, automatic restart operation after instantaneous power failure, forward/reverse rotation prevention, slip compensation, operation mode selection, offline auto tuning function, PID control, computer link operation (RS-485)
	Output signals	Operating status		2 open collector output signals can be selected from inverter running, up to frequency, frequency detection, overload alarm, zero current detection, output current detection, PID upper limit, PID lower limit, PID forward/reverse rotation, operation ready, minor fault and alarm, and 1 contact output (230VAC 0.3A, 30VDC 0.3A) can be selected.
		For meter		1 signal can be selected from output frequency, output current and output voltage. Analog output (0 to 10VDC).
Display	Operation panel display		Operating status	Output voltage, output current, set frequency, running.
			Alarm definition	Alarm definition is displayed when protective function is activated. 4 alarm definitions are stored.
	LED display			Power application (POWER), Alarm (ALARM)
Protective/alarm functions				Overcurrent shut-off (during acceleration, deceleration, constant speed), regenerative overvoltage shut-off, undervoltage (Note 1), instantaneous power failure (Note 1), overload shut-off (electronic overcurrent protection), brake transistor alarm, output short circuit, stall prevention, brake resistor overheat protection, heatsink overheat, fan failure (Note 4), parameter error, PU disconnection, output phase failure protection, ground fault overcurrent protection, option alarm, 24VDC power supply short circuit.
Environment	Ambient temperature			-10°C to +40°C (14°F to 104°F) (non-freezing)
	Ambient humidity			90%RH or less (non-condensing)
	Storage temperature (Note 2)			-20°C to +65°C (-4°F to 149°F)
	Ambience			Indoors (no corrosive and flammable gases, oil mist, dust and dirt.)
	Altitude, vibration			Maximum 1000m (3280.80 feet) above sea level for standard operation. After that derate by 3% for every extra 500m (1640.40 feet) up to 2500m (8202.00 feet) (91%). 5.9m/s^2 or less (conforming to JIS C 60068-2-6)

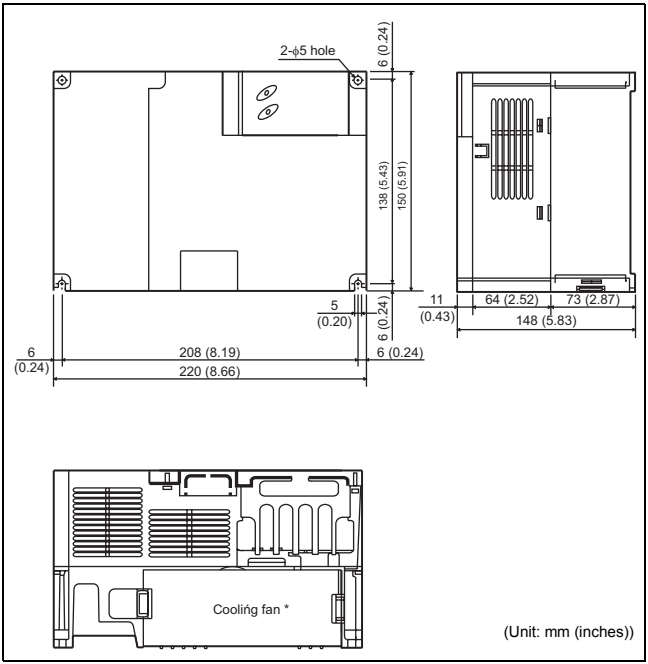
Note: 1. When undervoltage or instantaneous power failure has occurred, alarm display or alarm output is not provided but the inverter itself is protected. Overcurrent, regenerative overvoltage or other protection may be activated at power restoration according to the operating status (load size, etc.)
2. Temperature applicable for a short period in transit, etc.
3. The braking torque indicated is a short-duration average torque (which varies with motor loss) when the motor alone is decelerated from 60Hz in the shortest time and is not a continuous regenerative torque. When the motor is decelerated from the frequency higher than the base frequency, the average deceleration torque will reduce. Since the inverter does not contain a brake resistor, use the optional brake resistor when regenerative energy is large.
4. M4500E-001 is not equipped with a cooling fan.

7.1.3 Outline drawings

● **M4500E-001, 002, 003**



● **M4500E-005, 007.5, 010**



* The M4500E-010 has two cooling fans.

APPENDIX

This chapter provides "supplementary information" for use of this product.
Always read the instructions before using the equipment.

APPENDIX 1 Instruction Code List..... 196
APPENDIX 2 When using the communication option..... 200

APPENDIX 1 Instruction Code List

Function	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
Basic functions	0	Torque boost	00	80	0
	1	Maximum frequency	01	81	0
	2	Minimum frequency	02	82	0
	3	Base frequency	03	83	0
	4	Multi-speed setting (high speed)	04	84	0
	5	Multi-speed setting (middle speed)	05	85	0
	6	Multi-speed setting (low speed)	06	86	0
	7	Acceleration time	07	87	0
	8	Deceleration time	08	88	0
	9	Electronic thermal O/L relay	09	89	0
Standard operation functions	10	DC injection brake operation frequency	0A	8A	0
	11	DC injection brake operation time	0B	8B	0
	12	DC injection brake voltage	0C	8C	0
	13	Starting frequency	0D	8D	0
	14	Load pattern selection	0E	8E	0
	15	Jog frequency	0F	8F	0
	16	Jog acceleration/deceleration time	10	90	0
	18	High-speed maximum frequency	12	92	0
	19	Base frequency voltage	13	93	0
	20	Acceleration/deceleration reference frequency	14	94	0
	21	Acceleration/deceleration time increments	15	95	0
	22	Stall prevention operation level	16	96	0
	23	Stall prevention operation level compensation factor at double speed	17	97	0
	24	Multi-speed setting (speed 4)	18	98	0
	25	Multi-speed setting (speed 5)	19	99	0
	26	Multi-speed setting (speed 6)	1A	9A	0
	27	Multi-speed setting (speed 7)	1B	9B	0
	29	Acceleration/deceleration pattern	1D	9D	0
	30	Regenerative function selection	1E	9E	0
	31	Frequency jump 1A	1F	9F	0
	32	Frequency jump 1B	20	A0	0
	33	Frequency jump 2A	21	A1	0
	34	Frequency jump 2B	22	A2	0
	35	Frequency jump 3A	23	A3	0
	36	Frequency jump 3B	24	A4	0
	37	Speed display	25	A5	0
	38	Frequency at 5V (10V) input	26	A6	0
	39	Frequency at 20mA input	27	A7	0
Output terminal functions	41	Up-to-frequency sensitivity	29	A9	0
	42	Output frequency detection	2A	AA	0
	43	Output frequency detection for reverse rotation	2B	AB	0
Second functions	44	Second acceleration/deceleration time	2C	AC	0
	45	Second deceleration time	2D	AD	0
	46	Second torque boost	2E	AE	0
	47	Second V/F (base frequency)	2F	AF	0
	48	Second electronic thermal O/L relay	30	BO	0

Func-tion	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
Display functions	52	Operation panel/PU main display data selection	34	B4	0
	55	Frequency monitoring reference	37	B7	0
	56	Current monitoring reference	38	B8	0
Automatic restart functions	57	Restart coasting time	39	B9	0
	58	Restart cushion time	3A	BA	0
Additional function	59	Remote setting function selection	3B	BB	0
Operation selection functions	60	Shortest acceleration/deceleration mode	3C	BC	0
	61	Reference current	3D	BD	0
	62	Reference current for acceleration	3E	BE	0
	63	Reference current for deceleration	3F	BF	0
	65	Retry selection	41	C1	0
	66	Stall prevention operation level reduction starting frequency	42	C2	0
	67	Number of retries at alarm occurrence	43	C3	0
	68	Retry waiting time	44	C4	0
	69	Retry count display erasure	45	C5	0
	70	Special regenerative brake duty	46	C6	0
	71	Applied motor	47	C7	0
	72	PWM frequency selection	48	C8	0
	73	0-5V/0-10V selection	49	C9	0
	74	Filter time constant	4A	CA	0
	75	Reset selection/disconnected PU detection/PU stop selection	4B	CB	0
	77	Parameter write disable selection	4D	CD	0
	78	Reverse rotation prevention selection	4E	CE	0
	79	Operation mode selection	4F	CF	0
General-purpose magnetic flux vector control	80	Motor capacity	50	D0	0
	82	Motor excitation current	52	D2	0
	83	Rated motor voltage	53	D3	0
	84	Rated motor frequency	54	D4	0
	90	Motor constant (R1)	5A	DA	0
	96	Auto-tuning setting/status	60	E0	0
Communication functions	117	Communication station number	11	91	1
	118	Communication speed	12	92	1
	119	Stop bit length	13	93	1
	120	Parity check presence/absence	14	94	1
	121	Number of communication retries	15	95	1
	122	Communication check time interval	16	96	1
	123	Waiting time setting	17	97	1
	124	CR • LF presence/absence selection	18	98	1

Function	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
PID control	128	PID action selection	1C	9C	1
	129	PID proportional band	1D	9D	1
	130	PID integral time	1E	9E	1
	131	Upper limit	1F	9F	1
	132	Lower limit	20	A0	1
	133	PID action set point for PU operation	21	A1	1
	134	PID differential time	22	A2	1
Additional function	145	PU display language selection	2D	AD	1
	146	Parameter set by manufacture. Do not set.			
Current detection	150	Output current detection level	32	B2	1
	151	Output current detection period	33	B3	1
	152	Zero current detection level	34	B4	1
	153	Zero current detection period	35	B5	1
Sub function	156	Stall prevention operation selection	38	B8	1
	158	AM terminal function selection	3A	BA	1
Additional function	160	User group read selection	00	80	2
Initial monitor	170	Watt-hour meter clear	0A	8A	2
	171	Actual operation hour meter clear	0B	8B	2
User functions	173	User group 1 registration	0D	8D	2
	174	User group 1 deletion	0E	8E	2
	175	User group 2 registration	0F	8F	2
	176	User group 2 deletion	10	90	2
Terminal assignment functions	180	RL terminal function selection	14	94	2
	181	RM terminal function selection	15	95	2
	182	RH terminal function selection	16	96	2
	183	MRS terminal function selection	17	97	2
	190	RUN terminal function selection	1E	9E	2
	191	FU terminal function selection	1F	9F	2
	192	A, B, C terminal function selection	20	A0	2
Multi-speed operation	232	Multi-speed setting (speed 8)	28	A8	2
	233	Multi-speed setting (speed 9)	29	A9	2
	234	Multi-speed setting (speed 10)	2A	AA	2
	235	Multi-speed setting (speed 11)	2B	AB	2
	236	Multi-speed setting (speed 12)	2C	AC	2
	237	Multi-speed setting (speed 13)	2D	AD	2
	238	Multi-speed setting (speed 14)	2E	AE	2
	239	Multi-speed setting (speed 15)	2F	AF	2
Sub functions	240	Soft-PWM setting	30	B0	2
	244	Cooling fan operation selection	34	B4	2
	245	Rated motor slip	35	B5	2
	246	Slip compensation response time	36	B6	2
	247	Constant-output region slip compensation selection	37	B7	2

Function	Parameter Number	Name	Instruction Code		Link Parameter Extension Setting (Instruction Code 7F/FF)
			Read	Write	
Stop selection function	250	Stop selection	3A	BA	2
Aditional function	251	Output phase failure protection selection	3B	BB	2
	254	Analog polarity reversible lower limit	3E	BE	2
Computer link function	338	Operation command source	26	A6	3
	339	Speed command source	27	A7	3
	340	Link startup mode selection	28	A8	3
	342	E^2PROM write selection	2A	AA	3
DeviceNet™ functions	345	DeviceNet address startup data (lower byte)	2D	AD	3
	346	DeviceNet baudrate startup data (lower byte)	2E	AE	3
	347	DeviceNet address startup data (higher byte)	2F	AF	3
	348	DeviceNet baudrate startup data (higher byte)	30	B0	3
LONWORKS® functions	387	Initial communication delay time	57	D7	3
	388	Send time interval at hart beat	58	D8	3
	389	Minimum sending time at hart beat	59	D9	3
	390	% setting reference frequency	5A	DA	3
	391	Receive time interval at hart beat	5B	DB	3
	392	Event driven detection width	5C	DC	3
Additional Function	500	Communication error recognition waiting time	00	80	5
	501	Communication error occurrence count display	01	81	5
	502	Stop mode selection at communication error	02	82	5
Calibration functions	901	AM terminal calibration	5D	DD	1
	902	Frequency setting voltage bias	5E	DE	1
	903	Frequency setting voltage gain	5F	DF	1
	904	Frequency setting current bias	60	E0	1
	905	Frequency setting current gain	61	E1	1
	990	PU buzzer control	5A	DA	9
	991	PU contrast adjustment	5B	DB	9

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APPENDIX 2 When using the communication option.

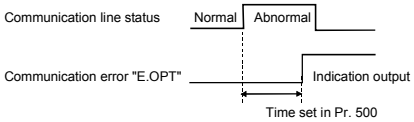
Operation at Communication Error Occurrence

The extended functions for E.OPT error and E. 3 error have been added to this instruction manual. (Pr. 500 to Pr. 502)

(1) Pr. 500 "communication error execution waiting time"

You can set the waiting time from occurrence of a communication line fault to communication error indication "E.OPT".

Parameter Number	Setting Range	Minimum Setting Increment	Factory Setting
500	0 to 999.8 s	0.1 s	0

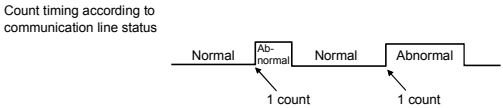


If a communication line fault still persists after the time set in Pr. 500 has elapsed, it is recognized as a communication error and the communication error indication "E.OPT" is output. If communication is restored to normal during the set time, operation is continued without a communication error indication.

(2) Pr. 501 "communication error occurrence count indication"

You can display the cumulative number of communication line faults that occurred. Write "0" to Pr. 501 to clear the communication error occurrence count.

Parameter Number	Setting Range	Minimum Setting Increment	Factory Setting
501	0	1	0



At the time when a communication line fault occurs, one count is made in Pr. 501 "communication error occurrence count indication".

Note: The communication error occurrence count indication is temporarily stored in RAM. As it is reflected to E^2PROM per hour only, performing power-on reset or inverter reset causes the last value stored in E^2PROM to display as the value of Pr. 501.

(3) Pr. 502 "stop mode selection at communication error"

You can select inverter operation to be performed in the occurrence of a communication line fault or an option error.

Parameter Number	Setting Range	Minimum Setting Increment	Factory Setting
502	0, 1, 2	1	0

(About the settings)

Fault	Pr. 502 Setting	At Occurrence of Fault			Error Recognition after Elapse of Pr. 500 Time			At Resolution of Fault		
		Operating status	Indi-cation	Alarm output	Operating status	Indi-cation	Alarm output	Operating status	Indi-cation	Alarm output
Communication line	0	Continued	No	Not provided	Coasting to stop	E.OPT lit	Provided	Stop held	E.OPT kept lit	Provided
	1	Continued	No	Not provided	Decele-ration to stop	E.OPT lit after stop	Provided after stop	Stop held	E.OPT kept lit	Provided
	2	Continued	No	Not provided	Decele-ration to stop	E.OPT lit after stop	Not provided	Restart	E.OPT kept lit	Not provided
Option error	0	Coasting to stop	E.3 lit	Provided	Coasting to stop	E.3 lit	Provided	Stop held	E.3 kept lit	Provided
	1	Decele-ration to stop	E.3 lit after stop	Provided after stop	Decele-ration to stop	E.3 lit after stop	Provided after stop	Stop held	E.3 kept lit	Provided
	2	Decele-ration to stop	E.3 lit after stop	Provided after stop	Decele-ration to stop	E.3 lit after stop	Provided after stop	Stop held	E.3 kept lit	Provided

Note: 1. A communication error [E.OPT (fault data: A0H)] is a fault on the communication line, and a communication error [E. 3 (fault data: F3H)] is a communication error inside the inverter.
2. The alarm output is the ABC contact output or alarm bit output.
3. If the Pr. 502 setting is 1 or 2, the deceleration time is the ordinary deceleration time setting (Pr. 8, Pr. 44, Pr. 45).
4. The acceleration time at restart is the ordinary acceleration time setting (Pr. 7, Pr. 44).
5. If the Pr. 502 setting is 2, the operation command/speed command at restart follows the command before occurrence of a fault.
6. For the setting of alarm output, the fault definition is stored in the alarm history.(Write to the alarm history is performed when the alarm output is provided.)If the alarm output is not provided, the fault definition overwrites the alarm indication of the alarm history temporarily but is not stored.After the fault is cleared, the alarm indication is reset and returns to the ordinary monitor and the alarm history returns to the original alarm history.
7. When a communication line fault, which occurred at the Pr. 502 setting of 2, is cleared during deceleration, acceleration restarts at that point. (Acceleration does not restart at occurrence of a Option fault.)

Switching mode between the PU operation mode and network operation mode (when used with a communication option)

You can switch operation between the PU operation and network operation from the operation panel (FR-PA02-02) or parameter unit (FR-PU04-MGI) during starting up in the network operation mode.

Pr. 340 Setting	Operation Mode		Mode at Power On or at Restoration from Instantaneous Power Failure
	Pr. 79		
10	0	PU or network operation	Inverter operates in the network operation mode. Operation mode can be switched between the PU operation and the network operation.
	1	PU operation	Inverter operates in the PU operation mode.
	2	Network operation	Inverter operates in the network operation mode.
	3	External/PU combined operation	Input running frequency from the PU and the start signal from outside.
	4	External/PU combined operation	Input running frequency from outside and the start signal from the PU.
	6	Switch-over	Inverter operates in the network operation mode. Operation mode can be switched between the PU operation and the network operation.
	7*	PU operation interlock	MRS signal ON..... Inverter operates in the external operation mode. (Operation mode can be switched to the PU operation mode by the parameter unit.) MRS signal OFF... Inverter operates in the external operation mode.
	8*	Operation mode switch-over by the external signal	X16 signal ON ..... Inverter operates in the external operation mode. X16 signal OFF .... Inverter operates in the PU operation mode.

* When Pr. 79 = "7 or 8", the inverter operates in the same manner as when Pr. 340 = "0". (The inverter will not operate in the network operation mode at powering on.)

When Pr. 340="10" and Pr. 79="0 or 6", operation can be switched between the PU operation and network operation from the operation panel (FR-PA02-02) or parameter unit (FR-PU04-MGI).

- FR-PA02-02

  Shifts to the PU operation mode when is displayed on the operation mode switching menu and shifts to the network operation when is displayed.

- FR-PU04-MGI

  Shifts to the PU operation mode when is displayed and to the network operation mode when is displayed.

REMARKS

1. Change of the Pr. 340 setting is made valid when powering on or resetting the inverter.
2. When copying parameters to the inverter which is not available with Pr. 340="10", the inverter operates in the same manner as when Pr. 340 ="0". For Pr. 340="0, 1", refer to the instruction manual of each communication option.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Dec., 2004	IB(NA)-0600222ENG-A	First edition

⚠ For Maximum Safety

- MGI general-purpose inverters are not designed or manufactured to be used in equipment or systems in situations that can affect or endanger human life.
- When considering this product for operation in special applications such as machinery or systems used in passenger transportation, medical, aerospace, atomic power, electric power, or submarine repeating applications, please contact your nearest MGI sales representative.
- Although this product was manufactured under conditions of strict quality control, you are strongly advised to install safety devices to prevent serious accidents when it is used in facilities where breakdowns of the product are likely to cause a serious accident.
- Please do not use this product for loads other than 3-phase induction motors.